SCIENTIFIC AMERICAN

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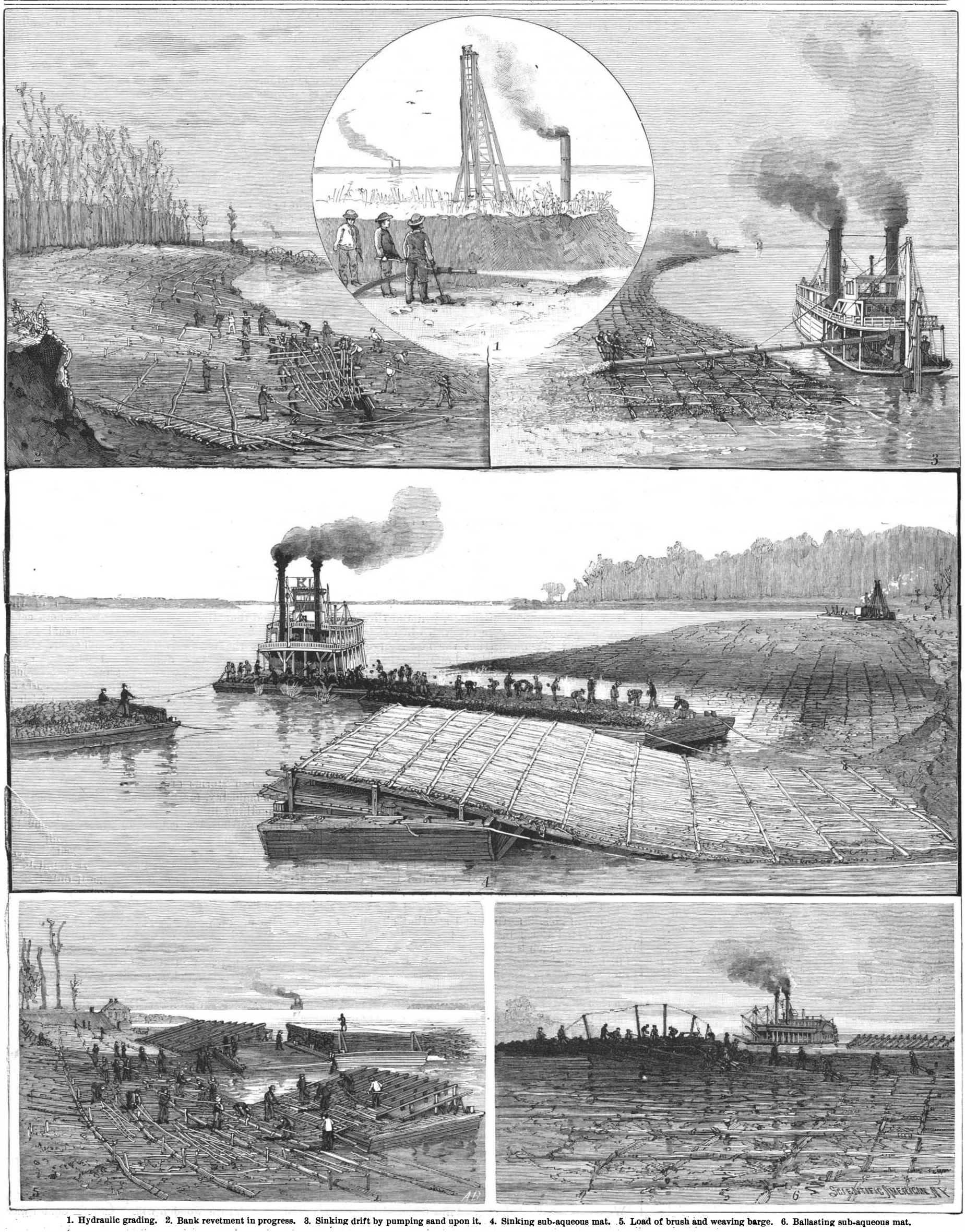

1. Hydraulic grading. 2. Bank revetment in progress. 3. Sinking drift by pumping sand upon it. 4. Sinking sub-aqueous mat. 5. Load of brush and weaving barge. 6. Ballasting sub-aqueous mat.

U. S. GOVERNMENT IMPROVEMENTS ON THE MISSISSIPPI RIVER AT PLUM POINT, ABOUT FIFTY MILES ABOVE MEMPHIS.—[See p. 405.]

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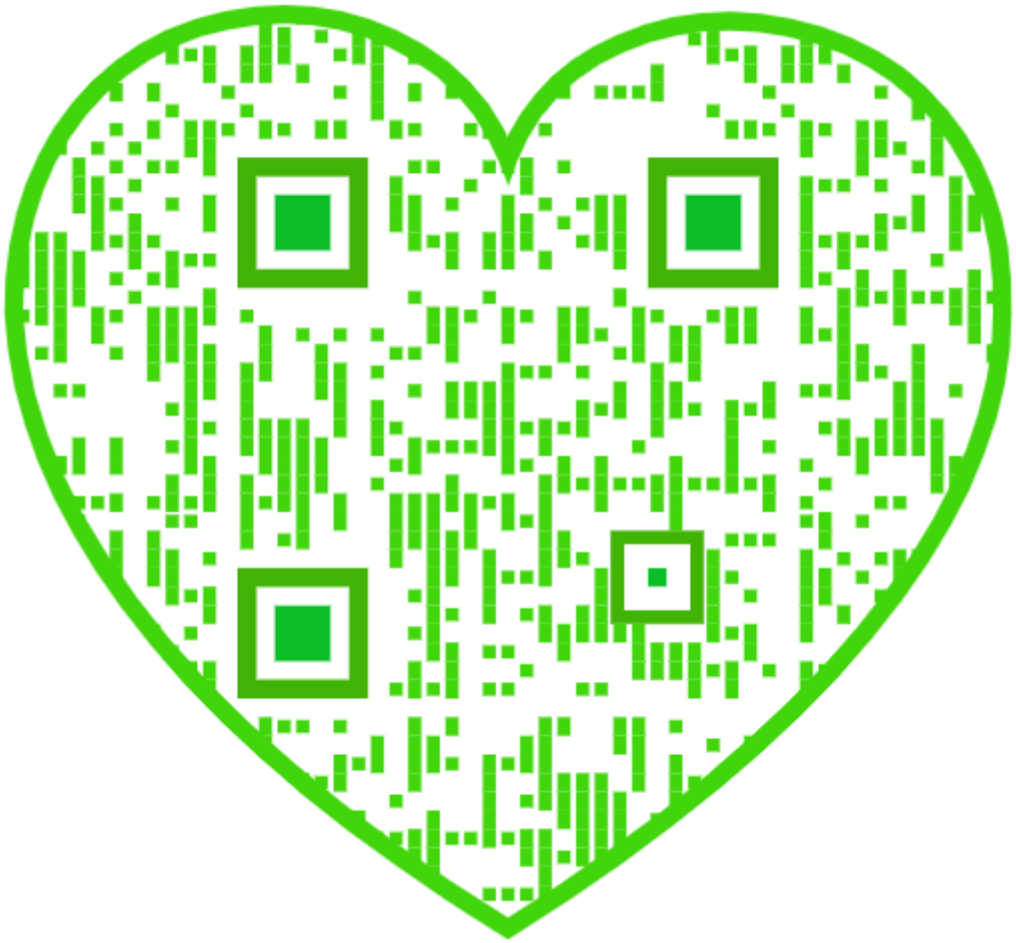

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Contents.

(Illustrated articles are marked with an asterisk.)

Acid, oxalomolybdic..... 404
Am. Ass. for Ad. of Sci..... 404
Animals, device for catching....*403
Appliances, railway..... 409
Back, spring, James'..... *403
Bicycles..... 402
Boats, torpedo..... *402
Business and personal..... 409
Chisel, carpenters', Palmer's... *404
Cleaner, flue, Oldfield's..... *403
Colors, beautiful, sources..... 404
Colors, complementary..... 408
Coupling, car, Nusly's..... *404
Coupling, car, Swenson's..... *403
Disaster, Johnstown *406
Dynamo and compass..... 400
Elevators, Otis, at Eiffel tower.. 402
Engineers, Am., European trip.. 404
Exhibition, Paris..... 401
Frame, crystallizing, Beller's....*403
Fund, Elizabeth Thompson..... 408
Gas, nat., in mnf. of steel..... 408
Girders, biggest..... 405
Granite..... 408
House for switch stands, McCarthy's.....*402
Improvements, Mississippi River*399
405
Inventions, agricultural..... 409
Inventions, electrical..... 409
Inventions, index of..... 409
Inventions, mechanical..... 409
Inventions, miscellaneous..... 409
Jack, flooring, Townsend & Winslow's.....*402
Keeping at it..... 404
Leaves, forms of..... 408
Locomotive exhibit, French..... 401
Mark, trade, advantages..... 408
Planets, position in July..... 401
Population of U. S..... 404
Signal, drawbridge, Long's.....*402
Silo presses and ensilage..... 405
Spindles, support for, Duffy's....*404
Sunshade for vehicles.....*403
Supply, water, New York..... 400
Telea polyphemus, notes on..... 405
Telescope, Lick..... 401

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 704.

For the Week Ending June 29, 1889.

Price 10 cents. For sale by all newsdealers.

PAGE

I. ARCHÆOLOGY.—The Origin and Manufacture of Playing Cards.—By GEORGE CLULOW.—A most interesting lecture recently delivered before the Society of Arts, in London, giving the history of playing cards and the different methods of manufacturing them used at different epochs, down to and including the present time.. 11240

II. CHEMISTRY.—Lecture Experiments.—By PETER T. AUSTEN.—Experiments showing the reactions of different oxides of nitrogen, and also with gaseous hydriodic acid.—1 illustration..... 11249

Nitrogen for Lecture Purposes.—By CHARLES P. C. TICHBOURNE, LL.D.—The production of pure nitrogen from ammonium sulphate and sodium nitrite, with formula and full details of manipulation..... 11250

III. CIVIL ENGINEERING.—Bridge over the Indus at Sukkur.—A new railway bridge recently completed in India, giving a peculiar modification of the cantilever structure.—1 illustration..... 11244

Mechanical Quarrying and Stone Cutting.—An interesting review of the machinery in the Traigneux Quarry, in the province of Namur, Belgium, illustrating the application of the continuous wire as well as of other machinery for cutting stone.—24 illustrations..... 11248

IV. ELECTRICITY.—A Model Electrical Manufactory.—By L. W. SERRELL, Jr.—A new factory of the C. & C. Electric Motor Co. in this city described, with a diagram of the current delivery at all periods of the day.—1 illustration..... 11249

V. MECHANICAL ENGINEERING.—A Three Hundred Horse Power Jonval Turbine.—A large turbine recently constructed in England for use in the Transvaal Gold Fields, adapted for transportation to the South African deserts.—1 illustration..... 11245

Pumping Machinery, Ancient and Modern.—First installment of a Sibley College lecture.—By Mr. J. F. HOLLOWAY.—Giving an exhaustive review of the direct-acting steam pump..... 11245

The Pulsometer.—By Prof. DE VOLSON WOOD.—The Pulsometer described and illustrated, with a mathematical analysis of its work and efficiency.—1 illustration..... 11244

Water Softening.—By GEORGE E. DAVIS.—A discussion of the proper treatment of water for use in boilers, with a view to the prevention of scale and corrosion by producing a soft deposit.... 11247

VI. MEDICAL.—Hypodermic Injections of Quinine in Malaria.—An excellent suggestion for malaria treatment, involving the subcutaneous application of quinine, with formula..... 11241

VII. MISCELLANEOUS.—The Catastrophe at Samoa.—A note of the disaster to the German ships, with illustrations of their wreck in the recent hurricane.—2 illustrations..... 11239

VIII. NAVAL ENGINEERING.—The Structural Strength of Sea-going Torpedo Boat No. 1.—By Lieut. F. J. DRAKE, U. S. Navy.—Commencement of a most elaborate review, with exhaustive calculations of the constants of the new sea-going torpedo boat.—5 illustrations..... 11242

IX. TECHNOLOGY.—A New Flexible Cloth.—An improved method of making twills, diagonals, and other double-backed cloths, with illustrative diagrams of the arrangement of the warp and weft threads.—3 illustrations..... 11247

THE WATER SUPPLY OF NEW YORK.

A record of draught is of interest to show what has taken place and of importance to show what is going to take place. When represented graphically, the record would take the form of a plane curve, that is to say, if at given intervals of time an enumeration of the people was made and the volume of water required by them was ascertained, the succeeding changes in draught would be clearly indicated by a line drawn through the points of intersection of the variable and the variant. It is practicable to calculate the data as to population which would form the values of the variable quantity, and the record of consumption would form the values of the variant; but the failure of the supply has imposed a condition in the equation, and hence the utility of the prolonged curve for determining the deficiency of supply at any time and in showing the wayward course of the true curve, which changes with abruptness as the storage is occasionally replenished, but which fails ever to assume its proper position.

In 1875 the per capita demand was *ninety-five* gallons and the draught by the city had reached the maximum delivery of the aqueduct. Since this time, therefore, the antecedent condition of the variable has alone been maintained, that is, the population has continued to increase, while the extent of this increase as exhibited by a greater draught has been relegated to the mercies of a prolonged curve.

In 1880 the indicated requirement was *ninety-seven* gallons per capita, equivalent to a daily delivery of 115 million gallons; but the actual delivery was only 99 million gallons, and hence the allotment was only *eighty-two* gallons, showing a deficiency of fifteen gallons to each person, or a total of 16 million gallons in the delivery.

In 1888 the indicated requirement was *one hundred* gallons, equivalent to a daily delivery of 161 million gallons. Prior to this date an additional supply of 10 million gallons had been received from the Bronx River, so that the actual delivery was 110 million gallons per day, making the allotment *seventy* gallons per capita, showing a deficiency of *thirty* gallons to each person, or a total of more than 50 million gallons in the delivery.

When the new aqueduct is completed, the deficiency will be partially made up, inasmuch as during the winter months the customary flow-off from the Croton basin can be utilized. Until such time, however, as the storage is increased by the completion of the Sodom dam, there will be no addition to the delivery during the summer months above what it is at present, and hence a calculation for the dry season of 1889 must be based on the prolonged curve. The indicated requirement for this and the following year is *one hundred and one* gallons, but the allotment will only be *sixty-six* and *sixty-two* gallons respectively.

Now the question is suggested, will the theoretical maximum daily delivery be attained when the Sodom dam is built? Assuming that the new reservoir thus formed will be in use in 1893, and allowing that the storage is thereby increased 5,000 million gallons, then the total storage of the Croton basin will be 14,700 million gallons. In this year the population will be two million and the daily theoretical consumption 200 million gallons.

But in order to provide for this volume daily, the estimated storage is 30,857 million gallons, showing a deficiency of storage provided of 16,157 million gallons. In other words, the capacity of the Croton watershed in the summer of 1893 will be approximately 135 million gallons per day, so that the demand will still exceed the supply, and the allotment, instead of being more than one hundred gallons, will be *sixty-six* gallons.

There are no projects on foot to restore the supply to its former volume, and it may be said that no part of the work contemplated in the Croton basin can be finished in time to modify this "say so" of the prolonged curve for 1893.

We might go still farther and say that although all the projected dams be built, including the Quaker Bridge dam, which is claimed to be "the largest work of its kind in the world," still the delivery could not be brought up to one hundred gallons per capita, for the reason that the population is increasing at such a high rate that it will reach the point where the demand is equal to the maximum capacity of the drainage area in 1897, while to complete all the necessary impounding reservoirs before this date is a physical impossibility.

In the following table is given the calculated requirement of each inhabitant, based on the records of past years, together with the allotment that has been furnished and will be furnished during the summer months of the years noted.

Date.	Per capita demand, gallons.	Allotment, gallons.
1840	20	20
1875	95	95
1880	98	82
1889	100	62
1893	101	66
1897	102	56

We have seen that the per capita demand has risen from *twenty* gallons in 1840 to *one hundred* at the present time. Whether this latter rate is high or low in comparison with that of other cities is immaterial—it is plainly not due to domestic use, but to features of an industrial and commercial character and therefore intimately connected with the prosperity of the city. To limit the consumption to *one hundred* gallons per day could not be taken exception to, provided there was any occasion for such limitation; but to allow the supply to be reduced to *seventy* gallons and less is to curtail enterprise, if not to defeat manifold industries that are already established.

To recite here the lines of manufacture and shipping that are dependent on a free and abundant use of water would be substituting a pleading from the people for emphatic criticism and give an entirely false aspect to the question. There is no benefit in dealing with hypotheses as to what business advantages this diminishing of the supply has deprived the city of, or in speculating on the dangers of a scant delivery in mid-summer, when it can be shown in an incontrovertible manner that the means adopted for procuring the additional water are not going to accomplish the end. What the people want next is evidence of abundance of water coming from somewhere—the testimony as to the need of such abundance was taken many years ago. The citizen gets no comfort in learning from the prolonged curve that his quota of water is to-day 30 per cent short of what he is entitled to. Has he not a right to be astonished that after the construction of the aqueduct and the Sodom dam, his allotment will be 35 per cent less than he is bargaining for? The choice of the Croton basin, with its "dry seasons," low cycle years, and untimely flow-off, has so occupied the authorities in its defense that the city has obtained a lead by growth which, according to the prolonged curve, it is going to maintain.

DYNAMO AND COMPASS.

The recent studies of Sir William Thomson of the effects of electricity upon the compass, as described in his recent paper, though not discovering a means of wholly protecting the needle from electrical influence, serves to point out at least one of the principal causes of it, and to indicate, with hopeful distinctness, the direction in which others may perhaps not unprofitably be sought for. War ships and passenger steamers—the only ones having electrical fittings—have not heretofore been able to protect their compasses from induced currents from the charged wires or from the magnetism of the dynamos.

At times the one or the other appears to exert an influence almost directly opposed to that of the mysterious something in the polar north to which the needle owes its allegiance. Sir William Thomson says that he has discovered, beyond peradventure, that, when single wires are employed—the ship's iron hull being used for the return conductor to the dynamo—there is the greatest disturbance, the widest deflection of the needle, and that the alternating system, where carefully installed, does not, save under unusual conditions, affect the true pointing of the needle. As to the effect of constant and vagrant currents upon the ship's chronometer, we do not propose to discuss that at this time, because in most, if not all, cases of complaint, the master has not been provided with a non-magnetic chronometer.

Only those used to the sea and familiar with navigation can fully appreciate the value of the investigations now being conducted by Sir William Thomson and other equally skillful electricians. When skies are clouded, when storms are come, the compass is the mariner's mainstay, for, by "dead reckoning," he may, with something like certainty, mark his way and hit his port; getting his course by compass, time by chronometer, and speed by log. When iron ships were first floated, the card compasses in use at the time were found wholly unfit to guide them by. It would have mattered little what the deflection was if only it had been constant, but it deviated. Ritchie came to the rescue with his liquid compass, immersing the needle in a bath of spirits of wine or alcohol, and by means of compasses in series, binnacle, bow, and tops, the mean local error is easily computed. Now come electric fittings, lights, and steering gear for passenger steamers and search lights, motors, firing apparatus, and other ingenious mechanisms for battery and pilot-house of men-of-war; admirable contrivances all, yet, if no way were found for encountering the mal-influence of those currents and their generator, it is hard to see how their presence could have been tolerated afloat. The careful mariner "swings" his ship before quitting port, to adjust his compasses, and while afloat is able to mark the deviation of their needles from true north by means of tables marked on his ocean chart. But, let such interferences as the dynamo and its currents interpose, and ship and crew are in imminent danger of destruction. The nautical as well as the scientific world has, then, cause for congratulation at the discoveries made by Thomson and others.

CARRIAGE manufacturers are predicting that in the not distant future wooden wheels will be done away with, and steel wheels substituted on account of the increasing scarcity of lumber for wheels.

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POSITION OF THE PLANETS IN JULY.

JUPITER

is evening star, and, as usual, during the month after opposition, is most favorably situated for observation. He rises before sunset on the 1st, and a glance at the southeastern sky will reveal his presence as soon as the twilight begins to fade. At the close of the month, he has so far advanced on his course toward the sun that he is on the meridian soon after 9 o'clock. He is very brilliant in spite of his great southern declination. Jupiter sets on the 1st at 4 h. A. M. On the 31st he sets at 1 h. 47 m. A. M. His diameter on the 1st is 44".6, and he is in the constellation Sagittarius.

VENUS

is morning star. She reaches her greatest western elongation, or greatest distance west of the sun, on the 10th, at 4 h. A. M., being then 45° 44′ west of the sun. After elongation, she retraces her steps toward the sun, her brilliancy slowly decreasing as she recedes from the earth. She will be a charming object in the morning sky throughout the midsummer month, especially on the morning of the 23d, when approaching conjunction with the waning moon. Venus rises on the 1st at 1 h. 50 m. A. M. On the 31st she rises at 1 h. 37 m. A. M. Her diameter on the 1st is 26".4, and she is in the constellation Taurus.

MERCURY

is morning star. He reaches his greatest western elongation on the 12th, at 5 h. A. M., and then, like his more brilliant neighbor Venus, begins to retrace his steps toward the sun. At elongation he is 20° 47′ west of the sun, and favorably situated for observation with the unaided eye, on account of his high northern declination. Mercury rises on the 1st at 3 h. 39 m. A. M. On the 31st he rises at 4 h. 17 m. A. M. His diameter on the 1st is 10".0, and he is in the constellation Taurus.

SATURN

is evening star. He is so near the sun as he approaches conjunction, that he will soon be hidden in the sunlight, setting less than an hour after the sun on the last day of the month. He is visible in the early part of the month in the northwest, moving eastward and slowly approaching Regulus. Saturn sets on the 1st at 9 h. 41 m. P. M. On the 31st he sets at 7 h. 52 m. His diameter on the 1st is 15".4, and he is in the constellation Leo.

MARS

is morning star, and makes seemingly little progress in his approach toward our planet. He rises on the 1st at 4 h. 11 m. A. M. On the 31st he rises at 3 h. 47 m. A. M. His diameter on the 1st is 4".0, and he is in the constellation Gemini.

URANUS

is evening star. He is in quadrature with the sun on the 9th at 8 h. P. M. He is in good position for telescopic observation, and may be easily found on account of his near approach to Spica. Uranus sets on the 1st at midnight. On the 31st he sets at 10 h. 3 m. P. M. His diameter on the 1st is 3".6, and he is in the constellation Virgo.

NEPTUNE

is morning star. He rises on the 1st at 2 h. 11 m. A. M. On the 31st he rises at 0 h. 15 m. A. M. His diameter on the 1st is 2".5, and he is in the constellation Taurus.

Mercury, Mars, Venus, and Neptune are morning stars at the close of the month. Jupiter, Uranus, and Saturn are evening stars.

The 36-Inch Lick Telescope.

We have received from Messrs. Warner & Swasey, Cleveland, O., who constructed the mountings of this great instrument, a fine print of same which they have lately caused to be engraved.

This instrument, the largest and most powerful refracting telescope in the world, was erected in 1888 at the Lick Observatory, which is located on Mt. Hamilton, in Santa Clara County, California. It is about fifty miles southeast of San Francisco, and twenty-six miles east of San Jose. It is 4,200 feet above sea level, and in sight of the southern end of San Francisco Bay.

The column is of cast iron, 10×17 feet at the base and 4×8 feet at the top, and weighs 20 tons. On this rectangular column rests the head, weighing 4 tons, in which is journaled the polar axis.

Around this head is a balcony, on which the assistant astronomer is stationed. By a system of wheels he is able to adjust the instrument on any star desired, and read its position by microscopes illuminated by electric light. Access to the balcony is gained by a spiral staircase on the south side of the column.

The polar axis is of steel, 12 inches in diameter, 10 feet long, and weighs 2,700 pounds. The declination axis is also of steel, is 10 inches in diameter, 10 feet long, and weighs 2,300 pounds.

The tube is of steel, 57 feet long. Its diameter is 4 feet at the center, tapering toward each end to 38 inches. The tube complete, with all its attachments, weighs 5 tons. This is made to follow the star by means of a driving clock, weighing one ton, controlled by a double conical pendulum which is placed near the top, and within the column, and is reached by a landing from the spiral staircase. At the side of the great tube three small telescopes of 6 inch, 4 inch, and 3 inch aperture are attached, which serve as finders.

The magnifying power ranges from 180 to 3,000 diameters.

The object glass is 36 inches clear aperture, and weighs, with its cell, 532 pounds. By special accessories the telescope is adapted to spectroscopic, photographic, and micrometric work.

The center of motion is 37 feet above the base, and when the telescope is pointed to the zenith, the object glass is 65 feet above the base of the column. When turning the instrument in declination, the weight that is put in motion is 7 tons, and when turning it in right ascension 14 tons is being moved. The total weight of the instrument is 40 tons.

The Paris Exhibition.

THE FRENCH LOCOMOTIVE EXHIBIT.

PARIS, June 5, 1889.

If as much could be said of the design of the French locomotives as can be said for the workmanship, this would be a grand exhibit for quality as well as magnitude, but the French seem to have got very little further than Crampton did in the improvement of the locomotive. Crampton undoubtedly did a very great deal for the locomotive of his day, but very little of it remains in present practice outside of France. When Napoleon the Second visited Queen Victoria the engine which took him from Dover to London was No. 149, a Crampton engine, with an intermediate crank shaft and having a single pair of driving wheels behind the firebox. A very large part of the journey was made at a speed of over 60 miles an hour. This class of engine has, however, gone out of use even in France, notwithstanding that it survived all other forms of Crampton engines in England. None of Crampton's designs was copied in America that I ever heard of, except perhaps the use of a perforated pipe running along the steam space, so as to dispense with the steam dome.

A very large proportion of the French locomotive exhibit consists of compounded engines, and in this case the Crampton plan of a return crank carrying the eccentrics serves well for the outside cylinders. Locomotive No. 2,367 of the Chemin de Fer du Nord is a compound six-wheel coupled engine with Crampton valve gear. In this engine there is a good deal of overhanging weight forward of the leading wheels—an alleged defect for which Bodmer's locomotive was condemned by the English government after it had run off the rails. Another exhibit of the same company has the Joy valve gear, which lends itself with many advantages to the compound system.

Locomotive No. 623, exhibited by the Chemin de Fer de l'Ouest, has inside cylinders, with Crampton valve gear. The coupling rods on this engine are outside the Crampton eccentrics, so that the return crank not only drives the valve gear, but also drives the trailing driving wheels—a construction which seems to me to be thoroughly bad. The valves are on top of the cylin der, inside the smoke box. The links for the valve gear are straight bars, the link itself lifting upward and the link die moving downward. On account of the eccentrics for the link motion being inside the side rods, the back driving-wheel axle box has a collar on it equal in thickness to the two eccentrics, this construction being necessary in order to keep the coupling or side rods in line. This engine is provided with a screw for working the reversing lever. The workmanship of this engine is exceedingly good. The Society Alsatienne des Constructions Mecaniques exhibit a compound locomotive in which the inside cylinders connect to the front pair of 5 ft. 6 in. driving wheels, while the outside cylinders drive the back pair of 5 ft. 6 in. driving wheels, the two pairs of wheels not being coupled. This arrangement I consider to be decidedly objectionable, considering that there is but little room for a receiver in a locomotive. A Joy's valve gear is employed for the outside cylinders, the slide spindle guide being suspended from the lower guide bar. In connection with this engine a peculiar feature of French locomotive practice may be noted, viz., that the steam chest comes in beneath the cylinders, and parallel with the ground, so that it can only be got at when the engine is standing over a pit. On speaking to a French engineer on this point, he answered, "We do not find it inconvenient. What could we want to get at the valves for, unless the engine is in the shop for examination or repairs? When we put the valves in, we put them in right and we attend to the lubrication properly, and if you in England or America have to arrange to get at the valves when the engine is in service, there is something wrong in your practice or construction." To an argument of that kind nothing can be said, unless one has statistics to fall back upon to show that it does or does not in practice prove inconvenient to place the cover in such a position.

The Chemin de Fer de Paris-Orleans exhibit engine No. 479 of 1889, which has inside cylinders, but Crampton valve gear with Gouch links. The piston stroke of this engine is greater than I ever saw in modern locomotive practice, being at least twice the piston diameter. A feature on this engine (the bracing of the inside cranks with iron hoops) is noticeable as representing common French practice. At the works of the Chemin de Fer du Nord at Hellemmes, they told me they found this necessary. But it is not found necessary in England (where a very large majority of the locomotives have inside cylinders, and therefore crank shafts), unless in the case of the appearance of cracks. Hence it naturally suggests itself that the use of the Crampton gear throws extra strain on the crank shafts, thus rendering the hooping necessary. The connecting rods of this engine have their straps and butt ends fitted with dies V-shaped at the ends—a construction rarely found nowadays in England or America. Another and not by any means a pleasing feature of this engine is that it is lagged all over with sheet brass, which is both unmechanical and in bad taste, besides being both ugly and expensive. The axle boxes are highly polished, in fact, burnished, as are also all that is visible of the springs. The buffer plates also are highly polished and have, at the back, some unnecessary fancy curves belonging to an era of the past when ogee scrolls were considered beautiful on engines or machines.

A compound locomotive on the Malet system appears among these exhibits to advantage, the high pressure cylinder being on one side of the engine and the low pressure cylinder on the other. This avoids a good deal of the excessive complication shown on some of the other compound engines, but it does not follow that it accomplishes what is required in a compound engine, and I may refer to it and some other features of French locomotives at a future time.

The Societe Alsatienne, Usine de Belfort, exhibit a locomotive with a valve gear composed of a sort of a trip mechanism actuated by a Crampton return crank and a rod from crosshead *a la* Joy. It is a wonderful compound of cam, screws, bevel gears, tongues, spiral springs, etc., all of a heap, and is doubtless the first, and is pretty sure to be the last, of its race. I hope the inventor had a good idea of what he wanted to accomplish, but cannot compliment him on his method of accomplishing it.

Another compound locomotive has the low pressure cylinder on the outside and a Joy valve gear. The high pressure cylinders are inside, with an ordinary link motion. The piston rods of the outside cylinders of this engine are, say, 3 inches in diameter and 10 feet long, passing through a bush guide provided in the guide bar hanger—a piece of designing not likely to be followed. There is one locomotive with a truck of the American form in the front, and I understand that, in a new and improved form of locomotive being got out by the Nord, the American truck is to be used, and some other features tending more toward English and American practice. The general appearance of French locomotives is not at all elegant or attractive to a mechanical eye, for there are too many bent pipes, cranked arms, and twists and turns in the various parts. It must be confessed that in this matter there is room for improvement in American practice too, and that the most pleasing and mechanical looking locomotive made is the English, with its straight lines and few bends or curves. It looks so simple and straightforward, and as if everything came fair in its proper place without having to be turned aside to get out of the way of something else. In French locomotive construction there is less uniformity than in any other I have as yet seen, and it seems quite clear that it is in a state of transition. At present, for example, you can find almost every form of connecting rod that can be found in the present or past practice of engine building, but at the same time the old patterns predominate. In link motions there are more old styles than new, and in valve gears a feature I never saw in any engine practice, and which I reserve until I have had a better opportunity of examining it.

The workmanship both for fit and finish on the French locomotives is very good, better, much better, than in either American practice. How much of the work is hardened in the case of steel, or casehardened in the case of iron, I have not as yet learned, but from the importance of this point I will look into it. There is not much cast iron work about these locomotives. I notice some steel wheels with solid webs, after the American style, and some wooden wheels on a locomotive truck, but wooden wheels have not found favor for locomotives either in England or France. All passenger carriages on English railways have wooden wheels (the Mansell pattern), and there is no doubt they are cheap, wear well, ride easy, and are easy upon the permanent way.

There are one or two locomotives here with very odd looking square smoke stacks, that are so large at the base as to create the suspicion that there might be a feed water heater inside them, but more of this anon. There is quite a large exhibit of French railway carriages and one or two dummies for street railways, but as this part of the exhibit is not quite complete, it may be reserved for the present. JOSHUA ROSE.

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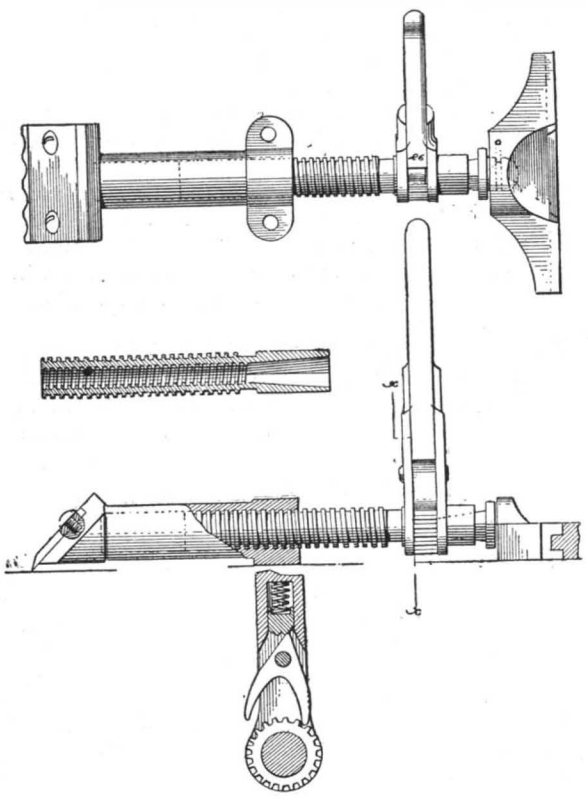
AN IMPROVED FLOORING JACK.

The illustration herewith represents a jack for laying floors, clamping sash, etc., which may be conveniently manipulated and used for various purposes. It has been patented by Messrs. Herman F. Townsend and Charles T. Winslow, of Groton Pond, Vt. The body has a threaded bore, and at its outer end has an inclined head or base, upon which is attached a plate having teeth in its lower edge, the plate being attached by screws, so that it can be readily removed. The inner end of the body has ears, whereby the device may be fastened to the floor or attached to the sides or ceiling of a building or room. A threaded spindle



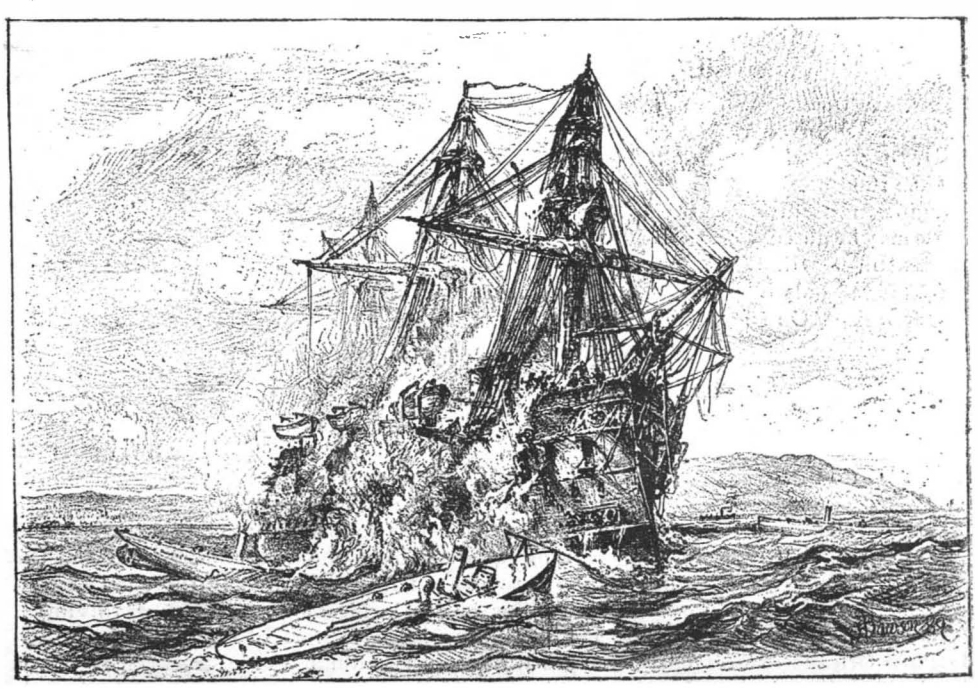
TOWNSEND & WINSLOW'S FLOORING JACK.

is secured in the bore of the body, this spindle being tubular and threaded on its interior, both interior and exterior threads extending to within a short distance of the outer end, which is enlarged and provided with a tapering rectangular bore and attached ratchet wheel. At each side of the latter are journaled the members of a lever, the inner end of which is bifurcated, or provided with arms attached upon opposing sides. In the end of the lever between the arms is a longitudinal recess in which is a spring having secured to its lower end a head-block with beveled sides and a central notch, the head-block being adapted to slide in the recess, as shown in one of the views. Between the arms of the lever and the head-block is pivoted a V-shaped dog, the angled body of which engages with the head-block and the members with the ratchet wheel, either member being thrown in engagement according to the direction in which the spindle is to be revolved. In operation, the teeth of the body-plate are driven into the floor beam, joist, or other support, and the clamp-block is forced forward by means of the ratchet lever, thereby revolving the spindle, which is interiorly threaded to admit of the attachment of a drill chuck or point, if it is found desirable to use the ratchet in that connection.

TORPEDO BOATS.

An able paper was read, not long ago, before the United Service Institution, by John Donaldson, on the recent improvements in Thornycroft torpedo boats. It was accompanied by various diagrams, among them an illustration, which we give, intended to show how these little vessels are expected to operate in attacking one of the great French ironclads. In the discussion, Admiral Barnaby, speaking of the torpedo boats, said:

"It is undoubtedly true that she can be pierced by shot. I have heard that so often said concerning big ships, for which I was responsible, that I can sympathize with our friends the torpedo boat builders when it is said that the shots can get in. Of course they can, and I have no doubt the people in the torpedo boat will feel terribly nervous when they are going to make the attack. But be perfectly sure the people will be very nervous on board the ironclad that is going to be attacked. That is an important thing. If you can succeed in making the other fellows nervous, never mind that you are running some risks yourselves. The real point lies, I think, there. It can be of no use to attempt to give protection against shot. I know that in France, where they have enormous ironclads of 11,000 and 12,000 tons, they are as nervous as can be over this fact, that the whole of their batteries can be searched out by machine gun fire. They know that, and they do not see how to remedy it. But if you cannot remedy it in a ship like that, what are you going to do with such vessels as these? The best thing you can do is to get a number of them and make them as good as ever you can."



HOW TORPEDO BOATS ARE MEANT TO ATTACK IRONCLADS.

Bicycles.

The Supreme Court of Indiana was recently called upon to review a non-suit in an action brought to recover damages for being struck down on sidewalk by a bicycle rider. The trial court had held that bicycling was a form of pedestrianating, and that the bicyclers had as much right on the sidewalk as any pedestrian. The appeal from the non-suit was argued in the forenoon. When the court adjourned for dinner, Judges Coffey and Berkshire started to walk to their hotel, and as they were passing out of the capitol grounds a clumsy bicycle rider ran into them, knocking both down, and badly bruising the former. This practical argument had such a convincing effect on the minds of the learned judges that they immediately overruled their unrendered decision and filed an opinion setting forth that a person who "rudely and recklessly" rides a bicycle against a man standing on a sidewalk is responsible for damages for assault and battery.

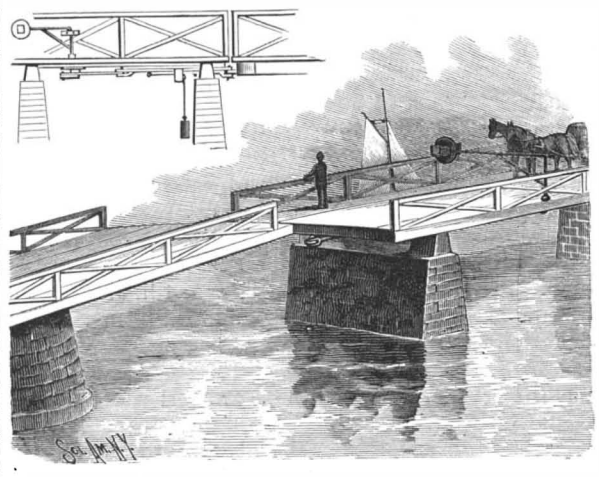
After quoting an Indiana law forbidding persons from riding or driving on the sidewalks, the court says: "If sidewalks are exclusively for the use of footmen, then bicycles, if they are vehicles, must not be ridden along them, since to affirm that sidewalks are exclusively for the use of footmen necessarily implies that they cannot be traveled by bicycles. It would be a palpable contradiction to affirm that footmen have the exclusive right to use the sidewalks and yet concede that persons not traveling as pedestrians may also rightfully use them. We think, however, that a bicycle must be regarded as a vehicle within the meaning of the law."—*N. Y. Law Journal.*

Testing the Safety Apparatus of the Otis Elevators at the Eiffel Tower.

At the Eiffel tower, an experiment was performed recently which produced a strong impression on those present. The engineer of the American firm of Otis subjected the Otis lift to a final test before handing it over for public use. The lift, the car of which consists of two compartments, one above the other, weighs 11,000 kilogs., and loaded with 3,000 kilogs. of lead—that is to say, weighing 14,000 kilogs—was raised to a considerable height. There it was fastened with ordinary ropes, and this done it was detached from the cables of steel wire with which it is worked. What was to be done was to cut the ropes, and allow the lift to fall, so as to ascertain whether, if the steel cables were to give way, the brakes would work properly and support the lift. Two carpenters armed with great hatchets had ascended to the lift, and were ready to cut the cables. At a given signal, a blow cut the rope. The enormous machine began to fall. Every one was startled, but in its downward course the lift began to move more slowly, it swayed for a moment from left to right, stuck on the brake, and stopped. There was a general cheering. Not a pane of glass in the lift had been broken or cracked, and the car stopped without shock at a height of ten meters above the ground.

AN IMPROVED DRAWBRIDGE SIGNAL.

A drawbridge signal, which shall be automatically displayed when the bridge is open, is shown in the accompanying illustration, and has been patented by Mr. M. H. Long, of Sabula, Iowa, the small figure giving a sectional view of the signal-operating mechanism. To the under side of each end of the draw is connected a double cam-faced flange, and upon the bridge approach is mounted a crane, which carries a

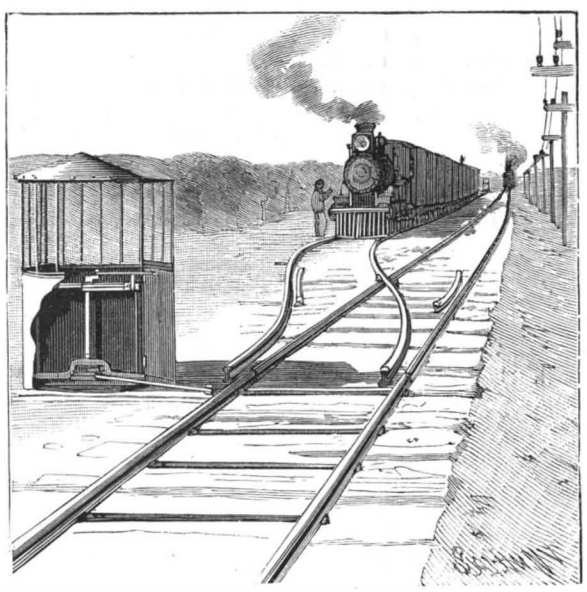


LONG'S DRAWBRIDGE SIGNAL.

disk, to serve as a day signal, and a box in which a lamp may be placed for a night signal. The crane is supported by a collar resting upon a wear-plate, centrally apertured to provide for the passage of the crane-standard, to the lower end of which is secured a sleeve, which carries a sliding lever-arm, pivotally connected by a link with one arm of a bell-crank lever mounted beneath, the other arm of the lever being connected to a slide. Upon the forward end of this slide is an anti-friction roll, borne upon by the cam-flange of the draw, so that when the latter is in closed position the disk-supporting arm will be held substantially parallel with the roadway. In order that this arm may be moved to indicate the open position of the draw, a weight is connected to the slide by a rope or chain, whereby, as the draw is opened, the disk-supporting arm is automatically carried to a position across the bridge roadway, being again returned to its normal position on the closing of the draw.

A LOCK-HOUSE FOR SWITCH-STANDS.

The accompanying illustration represents a strongly constructed house for a switchman, erected adjacent



McCARTHY'S LOCK-HOUSE FOR SWITCH-STANDS.

to the switch for a siding, to operate which the operator has to enter the house, and cannot again leave it till the switching rails have been returned to open the main track. The invention forms the subject of a patent issued to Mr. Wm. J. McCarthy of Menominee, Mich. The house, shown partly in section, is of sheet metal, with a lower flange adapted to be bolted to switch ties, the upper section of the house being open, for the convenience of the operator in giving signals, and having a sheet metal roof. Within the house is arranged a switch-stand of any proper construction, the vertical crank-shaft of the stand having an upper crank connected by a link to an eye secured to the inner side of the door. The vertical crank-shaft has the usual operating lever, which, when the siding is open, occupies a position to hold the door of the house closed, retaining the attendant until the lever has been thrown to a position to move the switching rails to open the main track. This construction is also designed to prevent the interference of meddlesome people with the switch rails.

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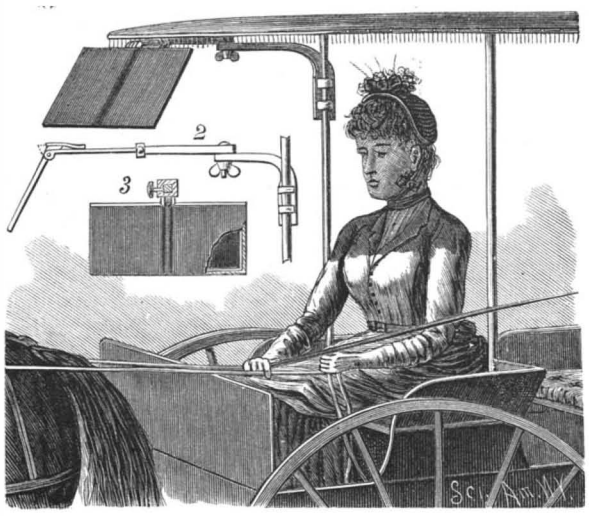
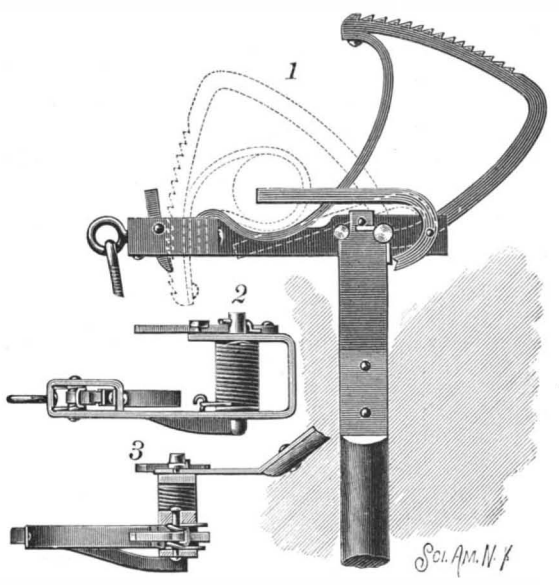
AN IMPROVED SUNSHADE FOR VEHICLES.

The accompanying illustration represents a simple and readily manipulated device, whereby the eyes of the driver may be shielded from the sun, while the device may be readily folded up and concealed out of sight when not desired for use. This invention has been patented by L. V. Luce, of No. 585½ St. Charles Avenue, New Orleans, La. Fig. 2 represents a



SUNSHADE FOR VEHICLES.

side elevation of the device, Fig. 3 showing the shade, partly in section. An angular bracket is adapted to be secured by clamps to one of the supports of the canopy of the vehicle, a horizontal arm being pivoted to the bracket, and this arm having a recess adapted to receive a rod with enlarged head, slotted to receive a lug forming a portion of the shade. This shade is preferably rectangular in form, and covered with cloth, leather, or other suitable material, the central bar of the shade frame terminating in the lug by which it is attached to the rod extending from the horizontal arm.

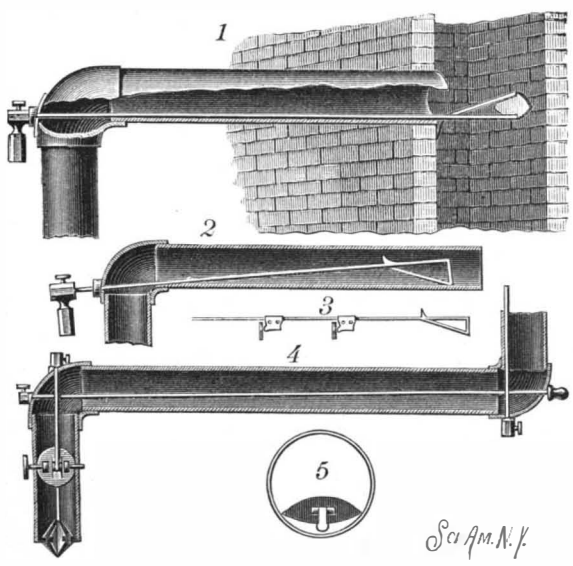


WICKHAM'S DEVICE FOR CATCHING ANIMALS

The device may be readily and conveniently attached to or detached from any vehicle; and by means of the thumb screw by which the horizontal arm is attached to the bracket, the shade may be conveniently moved to any desired position in front of or at either side of the driver, according to the direction in which the sun is shining.

A STOVEPIPE ANCHOR AND FLUE CLEANER.

The accompanying illustration represents a device for locking stovepipes to the chimneys, and also providing for the cleaning of the pipes. It has been patented by Mr. Leonidas H. Oldfield, of No. 72 West Washington Street, Chicago, Ill. Fig. 1 is a sectional view of the device when used to anchor a pipe to a chimney, and Fig. 4 represents a stovepipe tied therewith. Fig. 2 shows the device in position for use as a pipe cleaner, Fig. 3 representing the rod provided with additional cleaners, while Fig. 5 represents a cross section of pipe with additional cleaners, which, when not in use, are made to assume a horizontal position. The invention consists essentially of a rod with a spur extending from one side and a plate extending from the other side, a catch or handle being arranged in connection with the rod, the rod being held in place to lock the parts by a thumb screw on its outer end. To clean the pipe the handle is turned up to free the spur from engagement with the flue wall, bringing it into the position shown in Fig. 2, when the soot may be readily removed by reciprocating the rod.



OLDFIELD'S STOVEPIPE ANCHOR AND FLUE CLEANER.

AN IMPROVED ANIMAL CATCHER.

The illustration herewith represents a recently patented device specially adapted for catching hogs, sheep, etc., by the leg. Fig. 1 represents a plan view of the device, the full lines showing it as set for use, while the dotted lines represent the position of the parts when in engagement round an animal's leg. Fig. 2 is a side elevation of the device, and Fig. 3 a sectional end elevation. The main frame of the device has a handle by which the operator moves a tripping lever therein against the animal's legs, when the handle becomes detached, as the animal is caught, the operator then holding the animal by a rope attached to a ring in the other end of the frame. A shaft, actuated by a spring, is mounted to turn in the frame, the tripping arm being held on the shaft, while a segmental arm is also held on the shaft, and a band, preferably of leather, is secured to this segmental arm and to the frame. A spring pawl is fulcrumed on the frame and adapted to engage the notches on the segmental arm as it is brought to closed position, folding the leather band around the animal's leg, and locking it in place.

For further particulars with reference to this invention, address the inventor, Mr. Thomas Wickham, in care of James Wickham, No. 212 South Barstow, Eau Claire, Wis.

AN IMPROVED SPRING BACK FOR STOOLS, ETC.

A spring back for use on piano and organ stools, chairs, and office stools, and especially the high desk stools used in banks, etc., is illustrated herewith, and has been patented by William P. James, of Lincolnton, N. C. Figs. 1 and 2 represent side and rear elevations showing the device as applied, and Fig. 3 a sectional view. The seat may be of any desired shape, but the back support is connected thereto by a frame, preferably of round bar iron, having two downwardly projecting limbs, each suitably bent and formed with a crook where the frame comes close to the back of the seat. The frame is here connected to the seat by metal loops, and is further bent below to form a loop projecting inward beneath the seat. A spiral spring, bearing at one end against a plate secured to the under side of the seat, bears at its opposite end against the loop portion of the frame, which has its motion limited by working within a hook forming part of the spring-carrying base, to restrict the spring seat back from working either too far forward or backward. By this construction the frame is restrained from independent up or down and lateral movement, but is free to rock forward and backward.

CRYSTALLIZING FRAMES FOR MONOGRAMS, DESIGNS, ETC.

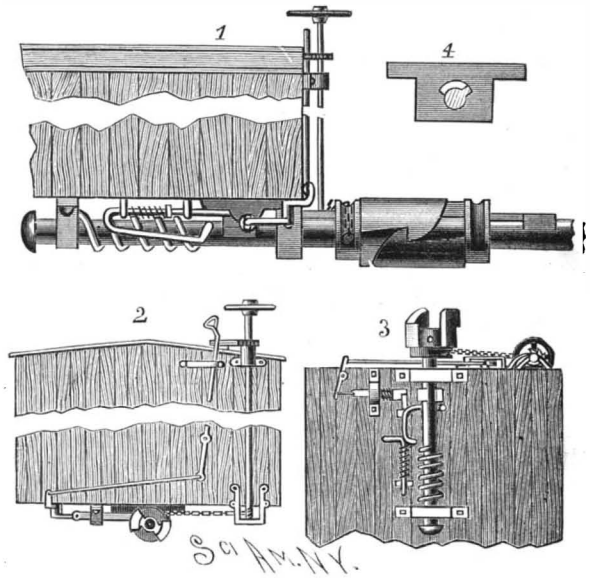
A special construction of frames prepared to retain crystals, as of salt, alum, or other crystallizing material, for the production of monograms, mottoes, and various designs, is illustrated herewith, and has been patented by Mr. Albert E. Beller, of Ogden, Neb., the illustration also representing an emblematic device thus produced. The frame is an open or skeleton one, formed of wire, wood, or other suitable strips, to inclose or support and form the design. These several wires or strips, or such portions as are intended to be incased by crystals, are then covered or wrapped with soft and flexible or fibrous material, to which the crystals will adhere. The whole frame thus covered is then steeped in any suitable crystallizing solution, and allowed to remain therein until a sufficient deposit of crystals has been made upon the covered portions, the uncovered parts of the frame being left bare by reason of the non-affinity of the crystals to form on or adhere thereto.

Advantage of a Trade Mark.

Last year, says the *Canadian Manufacturer*, a firm in London, Ont., inserted in the papers an advertisement of a stove polish, to which they gave the name "Nonsuch," and which they recommended in a card headed "Hello! Nonsuch." A gentleman who desired to write to the firm forgot their name entirely, but remembered distinctly the "Hello! Nonsuch." So he risked the consequences and addressed his communication to "Hello! Nonsuch, London, Ont," and the fame of the article, combined with the quick intelligence of the postal authorities, triumphed over every obstacle, and the letter reached its destination.

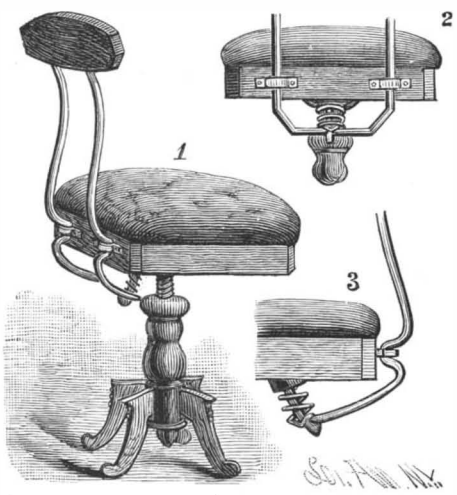
AN IMPROVED CAR COUPLING.

A car coupler designed to be automatic in its action, and preclude danger to the trainmen, by obviating the



SWENSON'S CAR COUPLING.

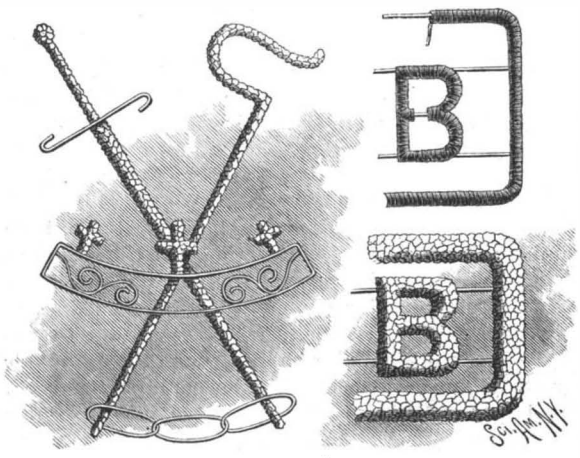
necessity of their going between the cars, is illustrated herewith, and has been patented by Mr. Alfred Swenson. Fig. 1 is a side view and Fig. 2 an end view of a portion of a car body provided with this coupler, Fig. 3 being an inverted plan view of the car body and coupler. The draw-bar is made integral with a draw-head having a central cylindrical section and two hooks, with inclined forward edges, and upon the draw-bar is a longitudinal rib, to the rear of which is a flat-faced boss or projection. The forward portion of the draw-bar is supported by a block having a recess within which the longitudinal rib rides, as shown in the sectional view, Fig. 4, such recess acting as a stop to prevent too great rotation of the draw-bar and coupling-head, while a spiral spring around the draw-



JAMES' SPRING BACK FOR STOOLS OR CHAIRS.

bar causes the rib to normally rest in the position shown in this figure. As two cars provided with this coupler approach each other, the inclined faces of the hooks on the forward ends of the draw-heads are forced to pass each other, when the main spring on the draw-bar causes the hooks to engage each other, as shown in Fig. 1, when the draw-heads are coupled. To uncouple the cars, a vertical shaft is operated, provided with a pawl and a ratchet, and a hand-wheel above the roof of the car. This shaft is connected to the draw-head by a chain bound upon a semi-sheave formed on the draw-bar just to the rear of the draw-head.

For further particulars with reference to this invention, address Mr. Peter J. Palmquist, Greenview, Ill.



BELLER'S CRYSTALLIZING FRAME.

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American Association for the Advancement of Science.

The thirty-eighth meeting of this association will begin in Toronto, Canada, Aug. 27, at the Queen's Hotel, the sessions to continue for a week, and the meeting closing with excursions extending to Sept. 7. A special circular in relation to railroads, hotels, etc., will be issued by the local committee, of which Mr. Charles Carpruael is president and Prof. James Loudon secretary, and members about changing their address for the summer should notify the committee. The officers elected for the Toronto meeting are:

President—T. C. Mendenhall, of Terre Haute, Ind.

Vice-Presidents—A. Mathematics and Astronomy—R. S. Woodward, of Washington. B. Physics—H. S. Carhart, of Ann Arbor, Mich. C. Chemistry—William L. Dudley, of Nashville, Tenn. D. Mechanical Science and Engineering—Arthur Beardsley, of Swarthmore, Pa. E. Geology and Geography—Charles A. White, of Washington. F. Biology—George I. Goodale, of Cambridge, Mass. H. Anthropology—Garrick Mallery, of Washington. I. Economic Science and Statistics—Charles S. Hill, of Washington.

Permanent Secretary—F. W. Putnam, of Cambridge, Mass. (office Salem, Mass.)

General Secretary—C. Leo Mees, of Terre Haute, Ind.

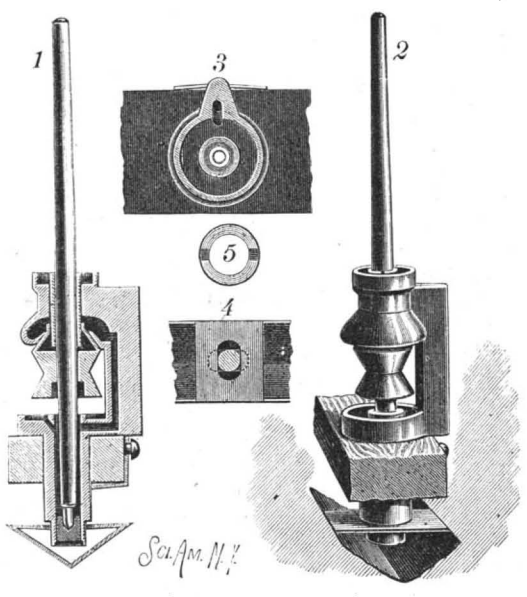
Secretary of the Council—Frank Baker, of Washington.

Secretaries of the Sections—A. Mathematics and Astronomy—G. C. Comstock, of Madison, Wis. B. Physics—E. L. Nichols, of Ithaca, N. Y. C. Chemistry—Edward Hart, of Easton, Pa. D. Mechanical Science and Engineering—James E. Denton, of Hoboken, N. J. E. Geology and Geography—John C. Branner, of Little Rock, Ark. F. Biology—Amos W. Butler, of Brookville, Ind. H. Anthropology—W. M. Beauchamp, of Baldwinville, N. J. I. Economic Science and Statistics—J. R. Dodge, of Washington, D. C.

Treasurer—William Lilly, of Mauch Chunk, Pa.

A SPINDLE SUPPORT FOR SPINNING MACHINES.

The accompanying illustration represents a spindle support from which the oil cannot be thrown out by centrifugal force, but will be properly distributed to the bearings, and the spindle kept clean. It has been patented by Mr. Joseph Duffy, of No. 48 Wayne Avenue, Paterson, N. J. Figs. 1 and 2 represent a vertical section and elevation of the device with the oil trough in section, Figs. 3 and 5 being horizontal sections through the tubular bearing of the spindle, and Fig. 4 a horizontal section near the base. The tubular socket portion which receives the lower end of the spindle has horizontal arms connected by a vertical portion, the upper horizontal arm having an aperture through which projects a tubular bearing for the spindle, the upper end of this bearing projecting into an annular chamber on the top of the arm and forming an oil chamber. The upper end of this bearing is formed with radial grooves, as shown in Fig. 5, to permit the passage of oil from the chamber down between the spindle and the tubular bearing. Surrounding the lower end of the aperture in the upper arm is an annular chamber, into which projects the neck of a whirl mounted on the spindle, the whirl having an annular chamber with inclined sides. From one side of the upper annular chamber an oil passage extends down through the vertical arm and the lower horizontal arm to the tubular socket at the base, and beneath the whirl, in the top of the lower horizontal arm, is an annular oil chamber also connecting with the socket at the base. As the spindle revolves, the oil works down into the upper annular chamber, the inclined sides of which prevent its escape, the oil returning to the spindle and up its tubular bearing when the spindle is at rest. Should this chamber become overcharged, the oil is carried by centrifugal force into an outer chamber and into passages finally leading to the tubular socket at the base.



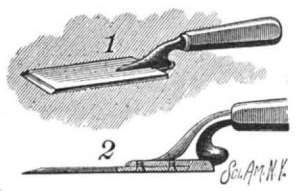
DUFFY'S SUPPORT FOR SPINNING SPINDLES.

The American Engineers' European Trip.

Some weeks ago we spoke of the visit of the different American engineering societies to Europe. With the Paris exposition as the central feature of interest, they proposed to visit engineering works of importance within an accessible distance. We have already printed a notice of their arrival in London and of the many receptions and entertainments to be tendered them. Already comments on the engineering works of England have begun to reach us from them, the contrast between American and English methods proving quite impressive. It is evident that both in the way of instruction and pleasure the trip will be a memorable one to all concerned, and that a crop of ideas will be gathered that may serve as a source of seed to reproduce in this country the valuable features of the more conservative engineering practice of the older lands.

PALMER'S IMPROVED CARPENTER'S CHISEL.

The illustration herewith represents a chisel or gouge for carpenters' use which has been patented by Mr. Theron H. Palmer, of San Bernardino, Cal. Figs. 1 and 2 represent top and side views of the device, which has its shank and handle portion bent out of line with its blade or cutting portion. The blade is provided with an anvil or hammer block at its rear to form a striking surface, when using a hammer or mallet with the tool to force it up to its work, instead of striking on the end of the handle direct, which is liable to split or bruise the handle.



A Curious Chemical—Oxalomolybdic Acid.

A new substance, singular alike in its chemical nature and in its properties, says *Nature*, has been discovered by M. Pechard. It is a mixed acid derived from oxalic and molybdic acids, and is, therefore, termed "oxalomolybdic acid." The crystals of oxalomolybdic acid, when dry, may be preserved unchanged either in sunshine or in the dark; but, if moist, they quickly become colored blue when exposed to the sun's rays. If characters be written on paper with the solution, they remain invisible in a weak light; but when exposed to sunshine, they rapidly become visible, turning to a deep indigo color. It is curious that this effect only happens when the solution is spread over paper or other surfaces; for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where, by surface action, a little is spread against the interior glass walls. If a sheet of paper be immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a very sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The color instantly disappears in contact with water; so that if a piece of this sensitized paper be wholly exposed to sunlight, one may write in white upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes to black, and the characters are then no longer destroyed by water

Keeping at It.

It is a great mistake to suppose that the best work of the world is done by people of great strength and great opportunities. It is unquestionably an advantage to have both these things, but neither of them is a necessity to the man who has the spirit and the pluck to achieve great results. Some of the greatest work of our time has been done by men of physical feebleness. No man has left a more distinct impression of himself on this generation than Charles Darwin, and there have been few men who have had to struggle against such prostrating ill health. Darwin was rarely able to work long at a time. He accomplished his great work by having a single aim, and putting every ounce of his force and every hour of his time into the task which he had set before him. He never scattered his energy, he never wasted an hour, and by steadily keeping at it, in spite of continual ill health and of long intervals of semi-invalidism, he did a great work, and has left the impression upon the world of a man of extraordinary energy and working capacity. Success is rarely a matter of accident, always a matter of character. The reason why so many men fail is that so few men are willing to pay the price of self-denial and hard work which success exacts.—*The Christian Union.*

The Population of the United States.

The present estimated population of the United States is 64,000,000. The rate of increase, exclusive of immigration, is estimated at 1·8 per cent per annum—about 100,000 a month. By immigration the increase of population averages over 43,000 a month, or over half a million yearly. The aggregate annual growth from both causes will not fall much short of a million and three-quarters. The estimated foreign population is not far below 14,000,000.

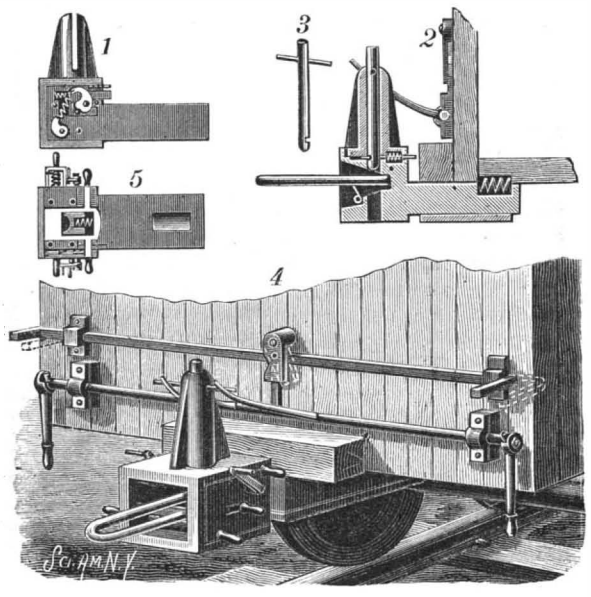
The Sources of Beautiful Colors.

The *American Druggist* has formulated a list of the choicest colors used in the arts, as follows:

The cochineal insects furnish a great many of the very fine colors. Among them are the gorgeous carmine, the crimson, scarlet carmine, and purple lakes. The cuttlefish gives the sepia. It is the inky fluid which the fish discharges in order to render the water opaque when attacked. Indian yellow comes from the camel. Ivory chips produce the ivory black and bone black. The exquisite Prussian blue is made by fusing horses' hoofs and other refuse animal matter with impure potassium carbonate. This color was discovered accidentally. Various lakes are derived from roots, barks, and gums. Blue black comes from the charcoal of the vine stalk. Lamp black is soot from certain resinous substances. Turkey red is mud from the madder plant, which grows in Hindostan. The yellow sap of a tree of Siam produces gamboge; the natives catch the sap in cocoanut shells. Raw sienna is the natural earth from the neighborhood of Sienna, Italy. Raw umber is also an earth found near Umbria and burnt. India ink is made from burnt camphor. The Chinese are the only manufacturers of this ink, and they will not reveal the secret of its manufacture. Mastic is made from the gum of the mastic tree, which grows in the Grecian Archipelago. Bister is the soot of wood ashes. Very little real ultramarine is found in the market. It is obtained from the precious lapis-lazuli, and commands a fabulous price. Chinese white is zinc, scarlet is iodide of mercury, and native vermilion is from the quicksilver ore called cinnabar.

AN IMPROVED CAR COUPLING.

A car coupling designed for use with a link and pin, and permitting an automatic coupling of two cars on a slight collision, while also adapted for the coupling of cars of different heights, is illustrated herewith, and has been patented by Mr. Vincent Nusly, of No. 718 Franklin Street, Sandusky, Ohio. Figs. 1 and 2 are sectional side elevations of the drawhead, Fig. 3 shows the coupling pin, Fig. 5 is a plan view of the drawhead with the top plate removed, and Fig. 4 is a perspective view of the improvement as applied. Supported by a suitable bearing in the bottom of the car is mounted to slide a bar on the front end of which is the drawhead, a spring holding the drawhead to permit a slight inward motion when two drawheads come together. In an offset on top of the drawhead the coupling pin is held to slide vertically, a notch in the lower end of the pin being engaged by a horizontal slide in the top of the drawhead, this slide having a rearward projection adapted to be engaged by a transverse beam on the front of the car, and having a projecting arm at each side of the drawhead for conveniently moving it by hand. A spring presses against the slide to hold it in engagement with the raised coupling pin until two drawheads come together, when the pin drops to engage the entering link. Near the upper end of the coupling pin are arms passing through vertical slots in the offset on the drawhead, the arms on the pin being adapted to be engaged by arms projecting from a shaft extending transversely on the front of the car, each outer end of this shaft having a lever by means of which the shaft may be turned to lift the coupling pin into its raised position. On this shaft is also fastened centrally an upwardly extending arm, adapted to be locked in place by a lock plate pivoted on the front of the car, and pivotally connected with a transverse rod, on each outer end of which is a handle for laterally moving the rod to disengage the lock plate, the locking of the arm holding the pin in its uppermost position when the cars come together, even if the slide is disengaged from the notch in the pin. In the drawhead is a link-raising mechanism, operated by handles at the side, whereby the link may be raised or lowered and held in the desired position to couple cars of different heights.



NUSLY'S CAR COUPLING.

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MISSISSIPPI RIVER IMPROVEMENTS.

For many years the question of the practical feasibility of confining the Mississippi River within fixed channels has been a most important one, not only as it affected the improvement of navigation over this great inland water course, but also from the necessity of protecting great properties along its banks, which have been frequently endangered by its fitful changes. In 1873, for instance, the banks of the river fronting the city of Memphis, Tenn., commenced rapidly caving in, the encroachment of the river destroying extensive sites and endangering costly structures, such as warehouses, elevators, cotton compresses, etc. In 1876 the bank had receded 350 feet, and was continuing to cave in at the rate of 100 feet per annum, thus promising to quickly destroy what had before been the finest harbor on the river above New Orleans, accessible to the largest vessels.

For a long time the national government has made annual appropriations for various improvements of the river, the most of the work so done having been originally for the construction and repair of levees, but in 1879 Congress passed an act organizing the Mississippi River Commission, to take more comprehensive action in regard to the whole matter, and of this commission Major-Gen. Q. A. Gillmore, of the engineer corps of the U. S. army, was president up to the time of his death, April 7, 1888. The general plan of work adopted by the commission contemplated the reduction of the low water width of the river below the mouth of the Ohio to about 3,000 feet by means of permeable dikes, behind which artificial banks should be formed by deposit, and the preservation of the natural curves of the river by reveting caving banks, together with the construction of levees.

Our first page illustrations represent the progress of this work at a portion of the river styled Plum Point Reach, about fifty miles above Memphis, Tenn. The river here takes a great bend into the Arkansas shore, and for a distance of some eighteen miles its channel was constantly changing, while numerous bars were formed, very seriously interfering with navigation. Previous to the commencement of these improvements the river at this point was frequently unnavigable for vessels of more than 4½ feet draught, while now, at the low water stage, it is navigable for vessels drawing 8½ to 9 feet. The work has been substantially completed about three years, requiring only slight repairs from year to year, while the natural current is evidently wearing the channel steadily deeper and making changes therein less likely to occur hereafter.

The principal form of protection for the banks shown in our views consists in firmly anchoring mats of light timber and brush, to extend from below to quite high water mark, these mats being connected, by the manner in which they are woven on board and moved to place, to form a continuous protection to the portion of the bank they cover. A break anywhere in this mat covering would soon be found by the current when the water rises, and great care is, therefore, taken to make this matting cover continuous before the weight of stone or other material which is to hold it down is put in place.

The general manner of conducting operations is pretty thoroughly indicated by our illustrations, although the details vary in different localities. The hydraulic grading shown in Fig. 1, and one manner of sinking mat by pumping sand upon it, as shown in Fig. 3, indicate some of the recent improvements in methods of conducting the work, the whole plant for carrying on which is owned by the government. Fig. 2 shows the weaving of the mat in place upon the bank. Fig. 5 shows the weaving barge, with a load of brush in convenient proximity thereto, the weaving being done on a special frame set at an angle against the bank, the mat as made, shown in Fig. 4, being moved down into position on a bed formed by longitudinal timbers and stakes, the mat being afterward ballasted by loose stones and the pumping of sand upon it. The progress of this ballasting and placing of the mat is shown in Figs. 5 and 6.

The results of the work done at this point on the Mississippi have been so satisfactory as to lead to the more steady prosecution of similar plans for improving other sections of the river. The point at which these improvements were made was notoriously the worst one below Cairo, yet during last year, a season of very low water, no trouble was found in navigating this section. The high water of the year was above the thirty-foot stage for fifteen days, yet all overflow was prevented for a distance of nearly thirty miles. In the similar work done for the protection of Memphis harbor, the success has been equally pronounced. This work was not completed until the fall of 1887, and much of that which was done at first proved inefficient, but with the later methods adopted it is said that not a stick or a stone can be seen to be displaced, and not a foot of earth has been lost behind the revetment. So great is the confidence of those doing business there in the permanence of the water front as now established, that manufacturing and warehousing concerns have lately erected extensive and costly additions to their buildings on the river bank, and the elevator and compress companies have built out on piles driven through the revetment, so as to recover a considerable portion of their lost space.

The cost of such work has been greatly reduced since the government commenced these improvements. What originally involved an expenditure of some $30 per foot of bank was, in the last portion of the work, done for about $12 per foot of bank. The cost of a subaqueous mat 150 feet wide constitutes about one-half the expense, but some of the mats used have been 250 to 300 feet wide. This is said to be the heaviest and most costly work of its kind ever put down, and the engineers claim that it will certainly protect any alluvial bank on the Mississippi River.

The work above described has been ably conducted under the supervision of Capt. Smith S. Leach and Capt. Wm. T. Rossell, of the corps of engineers, U. S. army.

The Mississippi River Commission consists of Col. C. B. Comstock, Lieut. Charles R. Suter, and Maj. O. H. Ernst, of the U. S. Engineer Corps; Mr. Henry Mitchell, of the Coast and Geodetic Survey; Messrs. B. M. Harrod and S. W. Ferguson, civil engineers, and Mr. Robert S. Taylor.

Notes on Telea Polyphemus.

I collected two cocoons of this beautiful moth last fall. As they happened to be free from parasites, I was fortunate enough to observe the very interesting manner in which they came forth. April 30, about noon, the end of one cocoon was noticed to be soft and moist. Every minute or two the moth could be seen struggling to push its way through the softened cocoon. In about ten minutes from the time it was first noticed, the moth burst through, and, drawing its enormous body out, it began to run hurriedly around to find a place suitable for the position necessary to the growth of its wings. Climbing up the window frame, it attached itself to the wood by the sharp hooks on each foot, and there, with its body hanging downward, it waited for its wings to grow.

When it first came forth, its wings, were less than an inch in length, but they grew so rapidly that in fifteen minutes they were longer than its body; in twenty minutes they were of full length, but were still very soft.

The reason for the insect being so anxious to get the right position immediately after emerging from the cocoon is that if the wings are cramped or held in a wrong position, they harden thus and prevent it from flying.

The other moth came forth about half an hour after the first one. I covered it with a low glass cover for about fifteen minutes. It kept running around and turning over on its back in the vain attempt to assume an upright position. Removing the cover, I allowed it to climb an upright stick, when it immediately became quiet. Its wings, which had been slowly expanding, now began to develop as rapidly as in the first one, but its forced imprisonment had ruined its beauty. The hind wings were creased and crumpled so that it could not fly.

During the development of the wings I could see the pulsations in the body as the blood was forced into the tubes of the wings. WALTER A. LYNN.

Silo Presses and Ensilage.

The following is a description of a silo press erected at the Agricultural Experiment Station at Minneapolis, Minn. There are two presses located in the barn, each 16 ft. square and 21 ft. in height. They are so arranged that the top of each is on a level with the thrashing floor of the barn and the bottom is on a level with the basement stables, thus facilitating the feeding of the animals. To a height of 11 feet are walls of stone, 18 inches in thickness, above which the walls are wood. The bed is of concrete, composed of one part Louisville cement, two parts sand, with enough water and gravel added to make a stiff mortar. The floor has a slope of one inch to the center, where is located a well 2 feet in diameter and 4 feet deep, filled with gravel and stones, the bottom being left open. The walls are boarded up with matched flooring, a space being left between that and the main wall for ventilation. Two thicknesses of tarred paper is tacked on to this lining, and over the paper another covering of matched flooring nailed on vertically. This gives an air-tight, water-tight, and frost-proof silo, and one which is constructed to facilitate filling and feeding, and is admirably adapted for preserving the ensilage.

For the greater preservation of the wood, the partition walls are only carried within an inch and a half of the floor, and before filling the silo a strip of tarred paper is folded and nailed to a strip of board at the bottom, one-half of the tarred paper lying on the floor and being held firmly in place when the silo is filled by the ensilage. This makes an air-tight joint when the press is filled, and when it is empty the paper is raised or removed, and a free circulation of air is established, which purifies the chamber and dries and preserves the board partitions. This method of construction, with the use of an air chamber, has proved satisfactory, and in spite of very severe winters has prevented the contents from freezing.

It is well to bear in mind in constructing a silo that it is only a preserving can on a large scale, and the same rules should be observed in both cases. The timber used may be rough, but it is necessary to make a liberal use of tarred building paper. The walls of the silo must always be vertical, that the contents may readily settle by gravity. They must also be strong enough to withstand a strong lateral pressure. It is absolutely essential that the bottoms and walls be air and water tight. It is preferable to divide the space intended for the silo into three equal compartments, so that they may be filled alternately to a depth of four or five feet and then allowed to ferment, the heat rising to 100 or 140 degrees before the section is again filled. The silo in practical use should not be too large, as it is advantageous to remove an inch or more from the surface daily, the ensilage thus being always found sweet and pure and before any mould can gather thereon.

The report of the Department of Agriculture also issues the following directions on the preparation and treatment of ensilage: Although any plant or vegetable fit for cattle food when green may be preserved for an indefinite period in the silo, Indian corn is considered the cheapest and best for ensilage. Such varieties of the corn should be planted as will reach maturity in an ordinary season in the section of the country in which it is to be raised. Plant in rows wide enough to admit of easy cultivation and just thick enough to allow each stalk to form a well developed ear. The crop should be gathered when the grain is fully formed, but in the doughy state, at which period it contains the greatest amount of digestible matter. Corn partially dried is equally desirable for the silo. The corn should be cut in about one-half inch lengths.

In filling the silo, care should be taken to spread it evenly as put in, to pack the corners and sides firmly, to cover the top with a layer of boards or plank. Spread over this a double layer of tarred paper, and then a layer of rough boards, and on the whole a moderate weight of from fifty to one hundred pounds to the square foot. The weighting material may be anything convenient, sand, gravel, or dirt in barrels, stone, fire wood, farm implements, for storage and the like.

Pits should not be opened until fermentation has ceased and the mass has cooled, which will be in from six to eight weeks from the time of filling.

In feeding from the silo, it is better to feed day by day from the top in uniform layers, rather than from top to bottom, as by this method the surface is not exposed long enough to the air to become sour.

Ensilage can be grown and preserved much cheaper than root crops, by the ordinary farmer, and will successfully take their place in feeding value.

Corn ensilage is not a complete feeding ration, as it is deficient in protein, and this must be supplied by some by-fodder, as bran, shorts, or oil cake.

The best results of feeding ensilage are obtained by using it in combination with dry fodder, the best of which is clover hay.

Ensilage furnishes a succulent and easily digested food, greatly relished by all animals during the winter months, when their diet would otherwise be confined to a regime of dry provender. The cheapness and ease with which the silo can be constructed, the certainty with which, when properly constructed, it will preserve the feed from injury, the low cost of raising the crop, and the great yield per acre as compared with hay crops, and the value as a cattle food, render this the cheapest provender a stockman can raise.

Such are the directions given by this report and such are the deductions arrived at.

The Biggest Girders Yet.

In the new addition to the American Museum of Natural History will be used the largest box or riveted girders ever used in the construction of a building, says the New York *Times*. These girders were designed by J. Cleveland Cady, the architect, to support the floors and partitions, and thus obviate the use of pillars or columns, the object being to give unobstructed floor room for the display of specimens. There are twenty-eight of these girders, measuring about sixty-two feet in length, and weighing 40,000 pounds each. They were landed on the North River front of the city in the neighborhood of Fiftieth Street, and the possibilities of modern trucking have been taxed in vain to transport them to their destination at Manhattan Square.

The longest and strongest trucks to be found were brought into requisition, and with twelve horses harnessed to each truck the attempt began. One truck collapsed in Fifty-seventh Street near Tenth Avenue, another at Seventy-seventh Street and Ninth Avenue, while a third, which was fortunate enough to reach the square without mishap, buried its wheels to their hubs and stuck fast as soon as it left the pavement of the street. The contractors have therefore found it necessary to construct a tramway across the square from Ninth Avenue to the building for the transportation of the girders.

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THE JOHNSTOWN DISASTER.

In our last issue we illustrated some of the features of the Johnstown disaster from sketches made on the spot by our special artist. These showed very clearly the general aspect of the scene after the water had done its work. These views we now supplement by reproductions of photographs of characteristic scenes which emphasize the resistless force of the torrent that swept down the Conemaugh valley. It is to be hoped that a tangible theory will be formulated by the committee of the American Society of Civil Engineers appointed to investigate the occurrence. It consists of the following members: J. Max Becker, president; James B. Francis, Wm. E. Worthen, ex-presidents; and A. Fteley. The latter gentleman is at present chief engineer of the new aqueduct. The society has delegated this committee to visit the scene of the disaster and report upon it.

The lesson, after all, seems to be the old one so often taught by engineering disasters, the necessity of allowing a large factor of safety. The late Alexander Holley spoke in his epigrammatic way of the factor of ignorance; this factor in the case of the dam and lake overflow was far too small.

The concurrent force of all the investigations made by engineers, including those specially detailed by our contemporary the *Engineering News*, is as follows: The spillway of the dam for nine years proved adequate for the overflow. On the day of the disaster its capacity was overtaxed. The water rose in the dam far above the level of its bottom. The pipes at the base were closed permanently. Had they been open, it has been calculated that they would not have sufficiently relieved the extra flood to have prevented the water from rising to the top of the dam. Moreover, the spillway was obstructed by a bridge, fish screen, and other obstacles which still further interfered with the outflow. The water began to pour over the crest, probably lowest at the center. The water pouring over the crest cut away the earthwork with greater rapidity, owing to its inferior construction. At every instant gaining strength, the great crevasse was soon made, and the lake emptied itself, with the disastrous results known to all. Had the spillway been of adequate size, the dam would have remained intact, and no life would have been lost.

The dam was originally built under the supervision of Mr. Wm. E. Morris, now deceased, who was principal assistant engineer of the Pennsylvania State canals. He had direct superintendence of the western division. Gen. Jas. N. Moorhead, also deceased, was constructing engineer in charge of the work. It was built of earth well rammed and watered and laid in horizontal layers. The remains of this structural feature are present in the step-like contour of the break. It was covered with rough stone on both faces. The five pipes that passed through its base were used for running off the water when it was required to feed the upper levels of the canal. They were not put in place to be used in an emergency only, but were part of the regular feeding apparatus of the canal system. When opened, the water ran down the South Fork and Little Conemaugh to Johnstown, where it entered the canal. About 1858 the use of the dam was abandoned by the State, and four years later the first break occurred. It was in July, 1862. The culvert through which the iron pipes were carried proved defective, and a quantity of water ran out beneath the dam. Little damage to outside property was done, but the dam was undermined and injured, and a depression was formed in its top. Incidentally, of course, the hard rammed layers were disturbed and disintegrated. After this accident the dam was left to itself with about ten feet of water in it until 1875. In May of this year it was bought by a private individual, who four years later sold it to three gentlemen, the organizers of the South Fork Hunting and Fishing Club. The dam was repaired, most of the work being executed in 1880. The five pipes at the base were permanently closed, and for nine years all went well. Eventually a heavy rainfall overtaxed the structure, and the great disaster occurred.

The dam cost, originally, $240,000. It covered an area of about 500 acres, impounding the water from fifty or sixty square miles of watershed. It was 72 feet high and 900 feet long, and formed a lake that held 480,000,000 cubic feet of water, or about 3,600,000,000 gallons. It has been spoken of as the largest artificial lake in the United States, but it was exceeded in size by the reservoirs formed by the following dams:

Croton dam, in New York—434 feet long, 284 feet being of masonry and the remainder of earth. The height is about 40 feet. The foundation of the dam consists of two lines of stone-filled cribs, with 10 feet of concrete between them. The down-stream face is curved, and faced with granite. A small crib dam 300 feet below forms a basin, which serves as a cushion to break the fall of the water. The back of the dam is filled with earth. Impounds 5,000,000,000 gallons.

Sweet Water dam, in National, Cal.—Rubble masonry in Portland cement; 98½ feet high, 46 feet thick at bottom and 12 feet at top. Of curved type, with radius of 213 feet; 360 feet long on crest. Impounds 6,000,000,000 gallons.

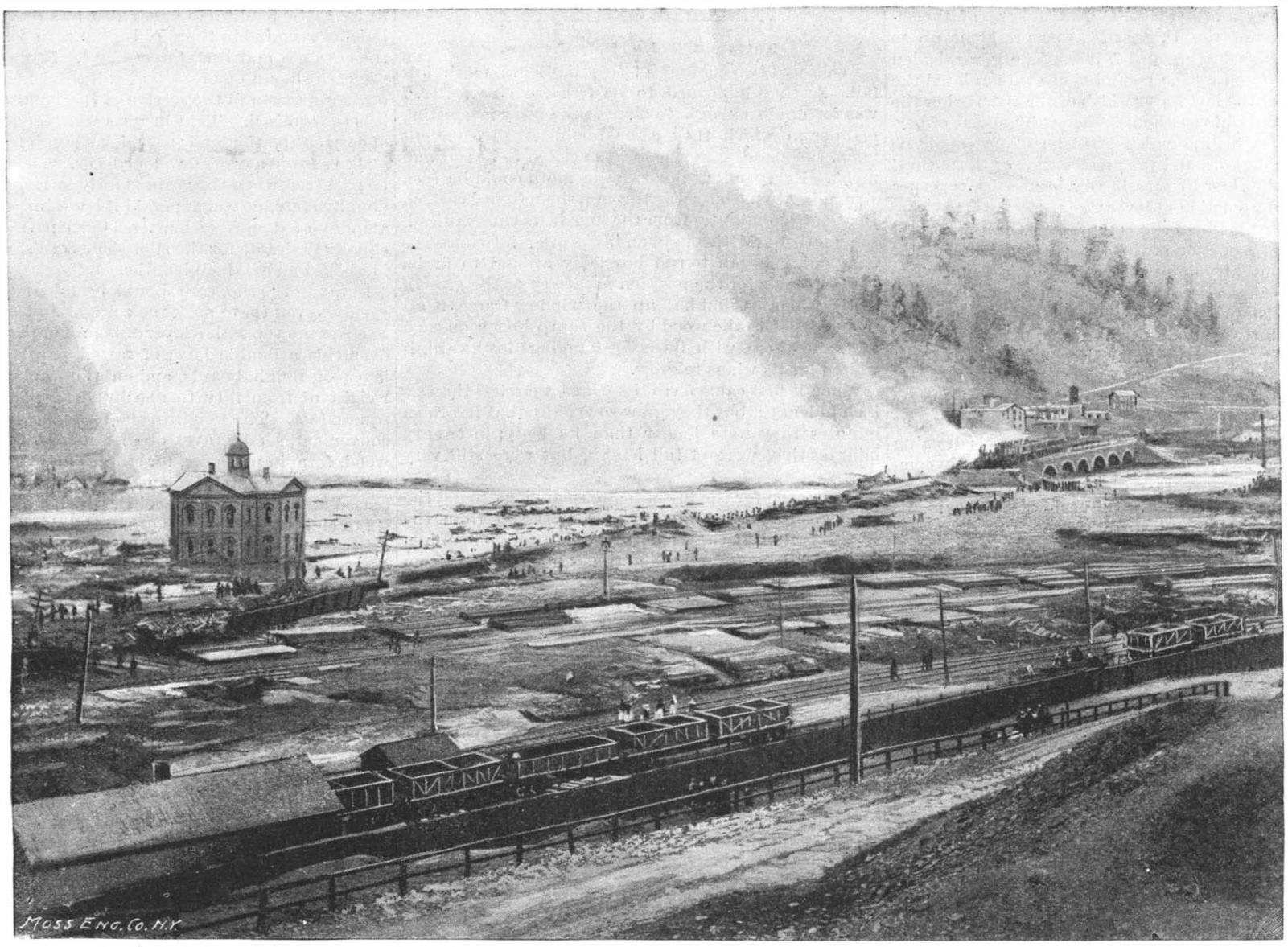
Dam at Oakland, Cal.—Earth, 80 feet high, 300 feet long, and 310 feet wide at base. Impounds 5,000,000,000 gallons.

Dam at Redland, Cal.—Bear Valley dam.—Granite masonry in cement; 64 feet high, 300 feet long, 20 feet thick at base, and 1⅔ feet at top. Curved type, with radius of 335 feet. Impounds 10,000,000,000 gallons.

Dam at San Mateo, Cal.—This is to be 170 feet high, 700 feet long, 176 feet thick at base and 20 feet thick on top. It is to be in Portland cement concrete masonry, and is to have a capacity of 32,000,000,000 gallons. It has only recently been begun.

The Quaker Bridge dam will, of course, dwarf all these. It will be 265 feet high from bed rock, with a base 216 feet wide. Ninety-nine feet of its base will be beneath the lake bottom, so that the visible masonry will rise 166 feet. It will impound about 37,500,000,000 gallons of water, forming a lake sixteen miles long.

Apprehensions have been expressed as to the effects of its breaking down. Should such an accident occur, the present Croton dam, which will undoubtedly remain intact and submerged, will lessen, to some extent, the flood. The valley between the Quaker Bridge site and the Hudson River is only two miles long, and has no settlement of any importance in it.



THE JOHNSTOWN DISASTER—THE SCHOOL HOUSE, THE ONLY BUILDING LEFT IN THE VICINITY. THE RAILWAY BRIDGE AND BURNING DEBRIS DRIVEN AGAINST IT.—(From a Photograph.)

At Johnstown the work of re-establishing the city has been actively carried on. Adjutant-General Hastings remains in charge of the work. A number of soldiers are encamped there for the preservation of order.

Work upon the gorge is still in progress. Stationary engines are in use to draw out the logs and heavier masses, large blasts of dynamite are applied to loosen the debris, and experienced loggers or raftsmen have proved of much help from their skill in handling floating timber. Corpses in an advanced state of decomposition are still found, over thirty having been discovered upon a single day last week. As fast as the remains of animals are extricated, they are burned upon the shores. A number of steam fire engines are on the ground, and have been utilized in pumping out the cellars.

The Pennsylvania railroad had about 3 miles of its roadbed washed away or buried beneath the debris. On the 13th of June, two weeks after the disaster, the line was again open and trains were running through to Pittsburg and the West. The engines carried away in the destruction of the Conemaugh round house were consolidation engines, and very heavy.

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None were carried less than 100 feet, some were transported 1,200 feet, and perhaps farther. Nearly twenty engines were scattered thus in all directions. Mr. McHenry, of the Cambria Iron Works, states that he saw an engine carried past that for an instant appeared to be floating on the surface of the water thirty feet above the ground. This gives an idea of the power of the water moving down the valley at such high velocity. For the excellent photographs herewith reproduced of the scene of the late disaster, we are indebted to the Dabbs photographic establishment, of Pittsburg, Pa.

The Polariscope as a Thermometer.

The polariscope has recently been applied in France to determining the temperature of incandescent iron and other metals. The color of a glowing mass of metal varies according to its temperature, and a ray of the light when polarized is rotated by a plate of quartz to a degree dependent upon the color. The degree of rotation is measured by the polariscope, and an empirical scale of temperature is thus obtained, which has been found very useful and reliable in metallurgical operations.

THE JOHNSTOWN DISASTER—VIEW ON ELM STREET.—[From a photograph.]

THE JOHNSTOWN DISASTER—VIEW ON MAIN STREET.—[From a photograph.]

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Granite.

The essential components of the true granites are quartz and potash feldspar. Although the essential minerals are but two in number, the rocks are rendered complex by the presence of numerous accessories which essentially modify the appearances of the rocks, and those properties render them of importance as building stones. These additional minerals are either present in such amount as to be conspicuous and to exercise an influence upon the appearance and structure of the rock, when they are called characterizing accessories, or they are present in such small amount as to be invisible to the naked eye, when they are called microscopic accessories. If all the minerals which by careful examination have been found in granites should be considered as constituents of the rock, then the latter would appear as very complex. At least two-thirds of all the known elements exist in granitic rocks, and the number of minerals that are liable to be present in special cases is very large.

The following list does not include all of those minerals which have been identified in this rock, for many have been found under circumstances which are so isolated that their occurrence is entirely exceptional. All of the minerals in this list are liable to be found at any time, and may therefore be considered as common constituents of the rock, although the presence of them all together is not to be expected, and some of them may be present in such minute amount as to be of no practical importance. Any one of them, save the two essential constituents mentioned above, may be absent from an individual specimen or from a given locality; and any one may be present in the specimens from a given locality in such amount as to give a character to the rock. Thus almost any one of those minerals which are given as microscopic accessories may assume the character of a characterizing accessory; this is especially true of the iron oxides, which sometimes are present in such amounts as to become characteristic:

Essential:
- Quartz.
- Feldspar.
  - Orthoclase.
  - Microcline.
  - Albite.
  - Oligoclase.
  - Labradorite.

Characterizing accessories:
- Mica.
  - Muscovite.
  - Biotite.
  - Phlogopite.
  - Lepidolite.
- Hornblende.
- Pyroxene.
- Epidote.
- Chlorite.
- Tourmaline.
- Acmite.

Microscopic accessories:
- Sphene.
- Zircon.
- Garnet.
- Danalite.
- Rutile.
- Apatite.
- Pyrite.
- Pyrrhotite.
- Magnetite.
- Hematite.
- Titanic iron.

Decomposition products:
- Chlorite.
- Epidote.
- Uralite.
- Kaolin.
- Iron oxides.
- Calcite.
- Muscovite.

Inclosures in cavities:
- Water.
- Carbon dioxide.
- Sodium chloride (salt).
- Potassium chloride.

—Prof. G. P. Merrill, in Gov. Report.

The Elizabeth Thompson Science Fund.

The Elizabeth Thompson science fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Conn., "for the advancement and prosecution of scientific research in its broadest sense," now amounts to twenty-five thousand dollars. As accumulated income is again available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points:

1. Precise amount required. 2. Exact nature of the investigation proposed. 3. Conditions under which the research is to be prosecuted. 4. Manner in which the appropriation asked for is to be expended. All applications should be forwarded to the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U. S. A. It is intended to make new grants at the end of 1889. The trustees are disinclined, for the present, to make any grant exceeding five hundred dollars. Preference will be given to applications for smaller amounts. The following is the list of grants made: $200 to the New England Meteorological Society, for investigation of cyclonic movements in New England; $150 to Samuel Rideal, Esq., of University College, London, England, for investigations on the absorption of heat by odorous gases; $75 to H. M. Howe, Esq., of Boston, Mass., for the investigation of fusible slags of copper and lead smelting; $500 to Professor J. Rosenthal, of Erlangen, Germany, for investigations on animal heat in health and disease; $50 to Joseph Jastrow, Esq., of the Johns Hopkins University, Baltimore, Md., for investigations on the laws of psycho-physics; $200 to the Natural History Society of Montreal for the investigation of underground temperatures; $210 to Messrs. T. Elster and H. Geitel, of Wolfenbuttel, Germany, for researches on the electrization of gases by glowing bodies; $500 to Professor E. D. Cope, of Philadelphia, Pa., to assist in the preparation of his monograph on American fossil vertebrates; $125 to E. E. Prince, Esq., of St. Andrews, Scotland, for researches on the development and morphology of the limbs of teleosts; $250 to Herbert Tomlinson, Esq., of University College, England, for researches on the effects of stress and strain on the physical properties of matter; $200 to Professor Luigi Palmieri, of Naples, Italy, for the construction of an apparatus to be used in researches on atmospheric electricity; $200 to William H. Edwards, Esq., of Coalburg, W. Va., to assist the publication of his work on the butterflies of North America; $150 to the New England Meteorological Society, for the investigation of cyclonic phenomena in New England; $25 to Professor A. F. Marion, for researches on the fauna of brackish waters; $300 to Professor Carl Ludwig, for researches on muscular contraction, to be carried on under his direction by Dr. Paul Starke; $200 to Dr. Paul C. Freer, for the investigation of the chemical constitution of graphitic acid; $300 to Dr. G. Muller, for experiments on the resorption of light by the earth's atmosphere; $300 to Professor Gerhard Kruss, for the investigation of the elementary constitution of erbium and didymium; $50 to Dr. F. L. Hoorweg, for the investigation of the manner and velocity with which magnetism is propagated along an iron bar; $150 to Mr. William H. Edwards, to assist the publication of his work on North American butterflies.

The Forms of Leaves and their Uses.

Even the most cursory observer of vegetable life must have been often struck with the various forms of leaves. Why they should be so variously formed does not, however, often suggest itself, though there is a reason for the special shape and texture of almost every leaf in existence. Plants, such as grasses, daffodils, and others which usually grow in clusters, have generally narrow leaves growing upright, so as not to overshadow one another. Other plants, of isolated habits, have an arrangement of foliage which secures to themselves the space of ground necessary for their development. The daisy, dandelion, or shepherd's purse—which may mostly be seen in pastures—are examples of this. A circle of broad leaves pressed against the ground, forming what is known as a rosette growth, effectually bars the approach of any other plant and keeps clear from all other roots the space of ground necessary to its own nutriment. Floating leaves, and leaves of marsh plants, are usually of simple outline, for, having few competitors, they are not liable to get in one another's light. Submerged plants have mostly leaves of narrow segments—the reason for which is not very well understood, though it is assumed by naturalists that it is for the purpose of exposing as large a surface as possible, in order to extract the minute proportion of carbonic acid dissolved in a vast bulk of water.

Leaves on the boughs of trees are often much divided, so as to fold easily, to prevent their being rent and torn by high winds, while the glossy surface of evergreens is intended to throw off rain and dew, which might freeze on them, and so cause injury to the tissues within. But the hairs on the surface of leaves are perhaps the most interesting study of all. With the aid of a microscope, the beautiful and systematic arrangement of these can be easily discerned, and their uses understood. On many plants there are glandular hairs, to catch or deter small creeping insects; on others there are hairs set so as to act as effectively against young animals as a spike palisade against obtrusive boys; on others, hairs which arrest the drops of moisture and force them down the leaf-stalk, to moisten the earth about the roots; while others are protected by a series of poisoned stings. The ordinary nettle is an example of this, and the beauty and ingenuity of its mechanism is truly wonderful. Each nettle hair is armed with a brittle and pointed siliceous cap, which breaks off in the wound; and the poison is then able to flow out through a tubular hair, from a reservoir at its base. There is scarcely a form of leaf but is specially modified by nature for some particular purpose, and the discovery of this purpose is a source of very pleasant and profitable study to young naturalists.—*Horticultural Times.*

The Manchester Ship Canal.

Some interesting statistics were lately given by Mr. Alderman Bailey, one of the directors, with reference to the progress of this work. He stated that 15½ million tons of earth and rock had been excavated, and that 28 million tons more remained to be removed. It was anticipated that the work would be finished in two years from 1st of January next. There were on the works 183 pumping engines, 82 steam navvies, 5,000 wagons, 158 locomotives, and 116 steam cranes, and in a few months 15,000 men would be employed. He further gave some particulars as to the cost of haulage of one ton, which was stated to be 6d. per mile on the highways, 2d. on the railways, 1-66d. per mile on the Leeds and Liverpool Canal, 1-116d. per mile on the Aire and Calder Navigation, and between New York and Liverpool about 1-300d. per mile.

Natural Gas in the Manufacture of Steel.

The process of James J. McTighe, of Pittsburg, for manufacturing steel is applicable to the production of the various grades thereof, from the soft kinds used for sheets and rails to that employed in the production of tools, needles, surgical instruments, etc.

He describes the process as follows: It has commonly been held that the brittleness of iron or steely irons is due, according as the iron is hot or cold, to the presence of an excess of sulphur or phosphorus. Discarding this theory, and assuming that the "cold-shortness" or "red-shortness" of iron or steel is due principally to an admixture of oxide of iron, I have devised a new method or process of manufacturing carburized iron, according to which, even though both sulphur and phosphorus be in excess in the metal, it is exceedingly ductile when of the soft variety and having the qualities demanded in steel intended for widely different purposes.

Hitherto in the manufacture of ordinary steel of low grades—such, for instance, as is used for rails, boiler plate, etc.—it has been customary to desiliconize and decarburize molten cast iron by blowing air over or through it. It is an acknowledged fact that this air leaves an oxide of iron mixed with the mass.

My invention has for its object to rid the entire mass of iron of all this injurious oxide as well as to recarburize it to the required degree, as also to purify it by the extraction of phosphorus, sulphur, etc.; and to these ends my invention consists in the combination of two processes—the one being the treatment of any kind of molten ferric compound, usually called "cast iron," by air or oxygen for the purpose of desiliconizing, decarburizing, and oxidizing the other being the, treatment of the same after the first step by commercial marsh gas, commonly known as "natural gas."

The first process need not be described, as it is practiced now in a variety of ways, and is well known to commerce as the "Bessemer" or "Siemens-Martin" method.

The second process consists in forcing natural gas through or over the bath of molten iron produced by the first process. The *rationale* of this second process is as follows: The gas disassociates the instant it comes in contact with the molten iron, as it always does in the presence of great heat, the carbon and hydrogen both assuming the nascent state. Carbon having in the presence of heat a great affinity for oxygen, deoxidizes the oxide of iron existing in the mass, thus producing a certain quantity of heat calculated to keep the mass in a molten condition. Hydrogen, on account of a similar affinity, assists in this reaction and result, and the twofold product—carbonic oxide or acid and hydric oxide—passes off as waste, the developed heat effectually preventing the chilling of the mass in the converting vessel. Simultaneously a further quantity of nascent hydrogen combines with portions of the sulphur and phosphorus, and forms, respectively, sulphureted and phosphureted hydrogen, which pass off as vapors, thus further purifying the product. It is also probable that a portion of the nascent carbon will unite with some of the sulphur to form bisulphide of carbon—another vapor that is at once carried off. A certain quantity of the nascent carbon unites with the molten mass of iron to form steel, which will be of high or low grade, according to the duration of the required described reaction.

The special features in the use of natural gas are:

First, its entire freedom from elements which might prove injurious to the steel, especially sulphur and phosphorus. This feature is not found in any gas made from any kind of coal.

Secondly, in the comparatively low amount of carbon it contains, it being almost entirely marsh gas.

All other gases made from petroleums, oils, fat, etc., are very rich in carbon. When such carbons are brought into contact with molten iron, the amount of carbon disassociated by heat is so great as to chill the mass at once or leave flakes of uncombined carbon distributed throughout the mass, which, when the iron is rolled into thin sheets, appear on the surface and effectually prevent its being properly galvanized or tinned. The percentage of nitrogen and free hydrogen shown by some analyses to be in natural gas obviously diminishes the risk of producing such carbon flake.

By the use of natural gas a practical and cheap substitute is obtained in place of the expensive spiegel iron heretofore adopted, and a fine quality of excellent steel of any desired grade is obtained economically and commercially, the same furnace producing, as desired, rails or plate, or sheet or razor, or wire, or cast or malleable steel, a result heretofore never hoped for. These various grades of steel will follow the varying amounts of carbon allowed to combine with the molten iron, and they can be in practice regulated with the scientific precision of chemistry.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR AXLE BOX. — Edward Leslie, Orangeville, Ontario, Canada. The bearing herein provided for is adapted for the standard box, the angular motion of the axle being allowed for, while a narrow bearing brass can be used, which is properly supported at the upper part, a flat key fitting into the casing provided with a central aperture, while an intermediate plate is held on the under side of the key with a circular offset fitting into the aperture of the key.

CAR PLATFORM.—Robert S. C. Fuller, New York City. An auxiliary platform, capable of independent movement, is pivoted on the rigid platform of the car, whereby, when the cars are coupled, the platform of one will meet that of the opposing car, the platforms remaining in contact throughout their width irrespective of the curves of the road, while a gate folding at the side of the car may be opened to extend from one car to the other parallel with the outer sill of the platform.

CAR PUSHER.—Joseph C. Chrisman, Sewell Depot, West Va. This device is intended especially for pushing cars in coal mines, as well as for other uses, and has a base formed of two foot sections adapted to slip in one direction along the rail, and to clamp against any reverse movement, a slide bar being connected with one of the sections and sliding through the other, with lever connections between the latter section and the slide bar and a push bar or rod.

TRACK PLOW.—Edward Leslie, Orangeville, Ontario, Canada. This is an ice or snow plow designed to loosen any hardened snow or ice immediately next to the track, and having a flanger mechanism to remove snow or ice in proximity to the inside of the rail and discharge it a sufficient distance from the track to prevent its falling back.

Electrical.

BRUSH HOLDER FOR DYNAMOS. — Walter S. Bishop, New Haven, Conn. This is a simple and efficient device for holding the brush in the position of use with a light and uniform pressure, the brush being rendered adjustable in the holder by a positive screw movement, the brush-holding arm being pushed forward into contact with the commutator cylinder by a spiral spring, while there is an adjusting screw for moving the brush backward and forward through the brush socket.

ELECTRICALLY CONTROLLED ENGINE. —James E. Byrne, Brooklyn, N. Y. This invention relates to a hydraulic engine operating in connection with sheaves and cables, the latter attached to a car or cage to move it up and down, and provides means whereby the controlling valve is operated by electricity from the car instead of by hand power, and also for automatically reversing the car switch when the car reaches its upper or lower limits of travel.

Mechanical.

ANTI-FRICTION BEARING. — Bethuel G. and George H. Handy, Monroe, N. Y. This is a roller bushing for sheaves in which there is a rotary tubular box within an outer casing, and a series of rollers journaled in the box parallel with its axis, the faces of the rollers contacting with the inner side of the casing, and there being a space between the outer surface of the box and the rollers to prevent frictional contact.

PIPE TESTING MACHINE. — Michael Sexton, New York City. This invention provides for the use at each end of the pipe to be tested of a frame carrying a clamp screw with a packed head, one of the two clamp heads being provided with a testing fluid inlet, whereby water, steam, air, or other fluid may be forced into the pipe from a compressing apparatus, at any desired pressure, to discover sand or blow holes, splits, etc.

WATER WHEEL. — James T. Rohm, Locust Grove, Pa. Mounted in a closed casing is an upper horizontal rimless water wheel, having inclined buckets, and a lower horizontal water wheel having oppositely inclined buckets, with a surrounding rim extending upwardly and inclosing the other wheel, the opposite rotary motion of the two wheels being transmitted in one direction to a gear wheel.

LEVER FOR LOOMS.—Joseph A. Evans, Philadelphia, Pa. This is a shuttle-box-operating lever designed to improve the box lever of a power loom adapted for weaving fancy fabrics by making the lever in two parts and jointing it to work as freely as a solid lever, yet yield at the center to permit both ends to go up, should the plunger be arrested in its upward movement from the anchor wings becoming locked.

SPRAY CYLINDER FOR PAPER MACHINES.—Granville D. Crance, Valatie, N. Y. This invention covers a spray cylinder cleaner in which the cylinder has an extension at one end and a discharge pipe at the other, a rod with a handle fitting in one end of the cylinder, while at the other end of the rod is a swab, which is to be reciprocated in the cylinder for readily cleaning it.

Agricultural.

DISK HARROW. — George T. Booth, Christchurch, New Zealand. This invention provides means for securing the disks more firmly on the bolt or axle, to prevent excessive wear and tear, and also to regulate the pressure of the disks on the soil, and so that the pressure may be transferred to the outer or inner end of the disk bar, while wheels and axles are provided, so that the disks may be carried well clear of the ground while traveling.

COTTON HARVESTER. — Richard H. Purnell, Rosedale, Miss. This is a machine for picking cotton from the rows of plants in the field, a principal object being to prevent the team from knocking out the ripe cotton, for which the picking box is made to operate at two rows distant from the team, so that there will be between the team and the row of cotton being picked a row of picked plants, thus saving great waste.

HAY RAKE AND BALING PRESS. — John A. Hooton and Gilbert L. Wiard, Atkinson, Neb. This invention covers a combined machine of a hay rake and double baling press, with elevator, longitudinally extending baling boxes with alternately operating plungers, and a feeder delivering alternately into the boxes, taking up the hay from the swath, baling it, and dropping the finished bales in the field.

Miscellaneous.

STAMP CANCELER. — Benjamin Summers, Petersburg, Penn. This canceler has a main plate with a handle and parallel cheek pieces in combination with a tumbler, to which a rod is connected, blocks being held in ways between the cheek pieces and connected to the tumbler, whereby the down thrust of the handle will move the blocks in a straight line between the cheek pieces.

GRATE. — Salvatore J. Buzzini, New York City. This invention relates to grates for stoves, ranges, etc., the grates being made to reciprocate or shake preferably in straight horizontal directions to free the grate and fuel from ashes, and to swing to one side to dump the contents of the fire box, the invention covering various novel arrangements and combinations of parts.

COATING PAPER. — George Manahan and Henry Gade, New York City. This invention covers an apparatus for applying to one side of a web compositions of various kinds in a fluid form, provision being made for the required varying amount of the acting smearing surface, and the apparatus being mainly intended to be used in applying a preservative and weather proof composition to a web of paper for making sheathing or building paper.

SCIENTIFIC AMERICAN BUILDING EDITION.

JUNE NUMBER.—(No. 44.)

TABLE OF CONTENTS.

1. Elegant plate in colors, showing elevation in perspective and floor plans of a field stone residence, costing about nine thousand five hundred dollars. Page of details, etc.
2. Plate in colors of a cottage costing three thousand two hundred dollars. Perspective elevation, floor plans and details.
3. Engraving of the new Federal building to be erected at Worcester, Mass. Cost two hundred and fifty thousand dollars.
4. A cottage of moderate cost lately erected at Bedford Park, New York. Perspective and floor plans.
5. Plans and perspective of a convenient stable erected at Bedford Park, N. Y.
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7. A residence at Florence, Northampton, Mass. Cost ten thousand dollars complete. Perspective and floor plans.
8. Engraving of a half-timbered house at Chester, England.
9. View and plans of a fine barn lately erected near Providence, R. I.
10. A modern residence at Belle Haven Park, Greenwich, Conn. Perspective and floor plans.
11. A handsome house in the colonial style lately erected at "Renolds Terrace," Orange, N. J., at a cost of fifteen thousand dollars complete. Chas. A. Gifford, of London, architect. Perspective elevation and floor plans.
12. A cottage at Bedford Park, New York. Cost eight thousand five hundred dollars. Plans and perspective.
13. Engravings of the great Eiffel tower at the French exhibition.
14. St. Cloud Prebyterian Church, Orange, N. J. Potter & Robertson, architects, New York. Perspective elevation and floor plan. Cost seven thousand five hundred dollars.
15. Miscellaneous Contents: Brick piers. — Home decorations.—Delights of color.—Foundations in alluvial deposits.—Portland cement and sea water. —The effect of moisture on wood.—The weeping larch, illustrated.—Nashville's estimating rules.—Selected lumber.—The science of dry rot.—Sewage a protection against the teredo.—Ornamental borders, with illustrations.—Hot air *vs.* steam.—The new Catholic cathedral at Pekin.—Advantage of sanitary measures.—Which are the hardwoods? —An ideal living room.—A water motor for elevators, illustrated.—Granite rust. — Ventilating grates, illustrated. — French building laws. — Mahogany.—Artistic wood work, with illustrations.—Stains for mortar and plaster.—An enduring tin roof.—Wood filling and finishing.—Shell fish marbles.—Fire-resisting ceilings.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

June 11, 1889,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adding machine, D. E. Felt 405,024
Air cooling apparatus, J. L. Wood 405,064
Air engine, J. S. Baldwin 404,818
Animal trap, A. Brawn 405,006
Anvil and swage, J. H. Urschel 405,191
Asbestos, treating, B. E. Church 406,201
Assorting machine, Gooding & Ladd 404,904
Automatic sprinkler, J. Clapp 404,897
Axle box, car, E. Leslie 405,040
Back band pad, G. W. Moores 404,923
Bag. See Paper bag.
Bag lock, C. Reinisch 405,119
Baker's peel, G. A. Naumann 405,046
Baling press, F. W. Anderson 404,815
Baling press, J. H. Howard *et al* 404,972
Band cutter, C. H. Hill 404,840
Bar. See Binding bar. Exercising bar. Stretcher bar.
Battery. See Galvanic battery. Secondary battery.
Beach chair, C. E. Koechling 405,038
Bearing, anti-friction, B. G. & G. H. Handy 405,031
Bed pan, M. Riker 405,182
Bellows, O. Kullbom 405,103
Binder or file for documents, P. Garton *et al* 405,026
Binding bar, J. T. Richardson 404,865
Bit. See Drill bit.
Blind stop, M. B. Wesson 404,998
Boiler. See Steam boiler. Wash boiler.
Boiler, M. E. Irving 404,912
Boiler front and setting, H. L. Beach 404,821
Boiler stay, H. Schaubel 405,227
Boiler tube fastening, H. Schaubel 405,225
Boiler tubes, fastening, H. Schaubel 405,226
Bolster spring, H. Van Arsdale 405,192
Bolt and nut, A. M. Brainard 404,953
Bolt threading machine, A. Wood 405,236
Book, blank, N. H. Baker 404,817
Bosom pad, S. Wheeler 404,881
Bottle stopper, T. B. Howe 405,085
Box. See Axle box. Fruit box. Letter box.
Box binder, metallic, F. G. Johnson 404,842
Brake. See Carriage brake. Wagon brake.
Brakes, engineer's cock for air, G. A. Boyden 405,197
Brick, burning, J. C. Anderson 405,066
Brick machine, B. Owen 404,857
Bridge signal, draw, M. H. Long 405,042
Bureau or similar article of manufacture, Kathermann & Folk 405,166
Burner. See Gas burner. Hydrocarbon burner. Oil burner.
Button, P. A. Raymond 405,179
Cable grip, G. A. Carreras 405,145
Cable roads, slot rail for, M. M. Suppes 405,231
Calendar, C. K. Hamilton, Jr 405,160
Car coupling, R. J. Edwards 405,085
Car coupling, Greenway & Strickland 404,967
Car check, J. M. De Witt 404,901
Car gate, N. F. Mathewson 404,919
Car heating apparatus, J. F. McElroy 404,927
Car heating apparatus, P. L. McGovern 405,112
Car platform, railway, R. S. C. Fuller 405,025
Car pusher, J. C. Chrisman 405,012
Car replacer, R. W. Africa 405,143
Car, stock. M. D. Moore 405,107
Car windows, smoke and dust fender for, Waller & Carlstedt 405,060
Cars, alarm signal for cable and electric railway, Pfingst & Bemis 404,981
Cars, safety extinguishing attachment for heating and illuminating apparatus for railway, R. T. Smith 404,875
Cars, steam heating system for railway, J. F. McElroy 404,926
Carding machines, etc., cylinder for, G. O. Wickers 405,234
Carpet stretcher, Moylan & Griemsmann 405,171
Carpet sweeper, W. J. Drew 405,084
Carriage bow, G. L. Crandal 404,900
Carriage brake, baby, I. Levy 405,041
Carriage curtain knob, F. A. Neider 404,928
Carriages, prop block washer for, A. Searls 404,989
Carrier. See Cash carrier. Cotton carrier.
Cart, road, F. H. Boni 405,074
Cart, road, J. W. Coombe 405,081
Cart, spring, L. E. Walberg 405,193
Cartridge loader, A. Euston 405,152
Cartridge shells, device for uncapping and recapping, N. M. Muzzy 404,855
Case. See Latch case. Show case.
Cash carrier, W. H. Billing 404,887
Cash carrier, E. P. Zerbe 404,943
Cash carrier, Zerbe & Church 404,944
Cash carriers, adjustable curve for, F. S. Church 404,896
Cash register, W. C. McGill 405,111
Casting chill rings, apparatus for, H. Birkholz 404,888
Casting chill corrugated rollers, apparatus for, H. Birkholz 404,889
Casting machine, ingot, W. R. Hinsdale 404,909
Centering device, J. A. Painter 404,858
Centrifugal separators, means for lubricating, F. Hart 405,212
Chair. See Beach chair. Folding chair. Opera chair.
Cherry stoner, P. H. Reibisch 405,118
Cigar wrapping and rolling machine, C. W. Boman 405,073
Cleaner. See Grain cleaner.
Clock, electric alarm, B. Dubinski 405,206
Clock, electric alarm, W. E. Hadlock 404,906
Clock, electric self-winding, J. H. Gerry 405,089
Clock pendulum, J. Werner 404,937
Clock and coupling for barrels, casks, etc., combined, C. C. Linindoll 404,918
Cock, gauge, J. P. Strebig 405,129
Coin-actuated receptacle, E. C. Jones 305,215
Coffee mill, L. Drude 405,019
Coffin fastener, S. A. Scofield 404,872
Collar stuffing machine, C. Ewing 405,023
Condensing apparatus, C. C. Worthington 405,142
Conductor, underground, G. E. Tailleur 404,877
Cooker, steam, Schroyer & Penn 404,871
Cooking utensil, F. H. Ferguson 405,087
Coop, hen, E. Butterick 405,008
Corset, L. J. James 405,037
Corset, A. D. Nason 405,113
Cotton carrier, R. T. Smith 404,991
Coupling. See Car coupling. Thill coupling.
Cultivator, M. V. De Witt 405,204
Cultivator, G. Moore 404,922
Cultivator and cotton chopper, combined, A. H. Johnson 405,165
Cultivator, hand, H. C. Tubbs 404,995
Cupola or blast furnace, Hathaway & Stocking 404,908
Curtain pole, F. G. Johnson 404,841
Cutter. See Band cutter. Milling cutter.
Dental plugger, A. J. Sawyer 405,123
Derrick, L. S. Deming 405,082
Digger. See Potato digger.
Domino, C. M. Hyatt 405,164
Door, screen and storm, Weisendanger & Ulrich 404,999
Doors, roller for sliding, N. Clark 405,202
Draught equalizer, L. C. Harris 405,161
Draught spring, E. L. Hilderbrand *et al* 405,162
Drawer guide, D. W. Kendall 405,098
Dredging machine, H. S. Brown 404,891
Drier. See Grain drier.
Drill. See Grain drill. Rock drill.
Drill bit, J. Eagen 404,829
Drilling machine, electric, E. A. Sperry 405,187
Dyeing apparatus, E. Wood 405,141
Dynamos, brush holder for, W. S. Bishop 405,002
Earrings, mounting for, V. Gentner, Jr 405,157
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Electric motor, starting and stopping device, F. A. Perret 405,223
Electrical current generators, regulation of alternating, G. Pfannkuche 405,174
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Electricity by secondary batteries, distributing, W. W. Griscom 404,968
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Elevator. See Water elevator.
Embridering and edging machine, E. & R. Cornely 405,116
Embroidering machine, E. & R. Cornely 405,147
Engine. See Air engine. Electrically controlled engine. Low pressure engine. Rotary engine. Steam engine.
Engine shafts, electric indicator for, J. C. Ricketson 404,867
Engine shafts, electric signal for, J. C. Ricketson. 404,866
Engines, balanced piston for steam, W. J. Thomas 405,132
Engines, powder gas boiler for, O. & H. Schneider 405,229

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Motor. See Water motor.
Mower, J. H. Jones 405,238
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Oil burner, hydrocarbon, F. W. Minshall 405,219
Opera chair, D. Schustek 405,230
Oven, drying, P. McArthur 405,220
Package head, I. J. W. Adams 405,000
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Printing machine, F. H. Grote 405,159
Printing machine, F. Kirsch 405,099
Printing machine sheet delivery apparatus, A. R. Bartlau 404,951
Printing machine sheet delivery apparatus, G. P. Fenner 405,153
Printing machines, stop mechanism for web, L. C. Crowell 404,959
Printing machinery, J. H. Buxton *et al* 405,009
Pump, E. Neff 405,172
Pump, steam, N. J. Pritchard 405,116
Pulley bushing, Clark & Keasey 404,824
Rack. See Wagon rack.
Railway, electric, S. H. Short 404,873
Railway, suspended, J. Thomson 405,059
Railway switch, J. A. Duggan 405,020
Railway switch, J. T. Richardson 404,864
Rake. See Hay rake.
Reaping and mowing machines, apparatus for sharpening the cutters and fingers of, R. McGregor 404,976
Reel. See Fishing reel.
Reflector, lamp, G. W. Pelton 405,173
Refrigerator, M. S. Millard 404,854
Register. See Cash register. Hot air register.
Registering lock, J. Loewenthal 405,105
Regulator. See Temperature regulator.
Ring. See Finger ring.
Rock drill, steam, A. J. Sypher 405,127
Roofing plate, metallic, L. L. Sagendorph 405,122
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Sash fastener, W. Koenen 404,916
Sash holder, C. A. Krafft 405,101
Sash holder, A. W. Nelson 404,977
Sash holder, E. Reed 405,180
Sash ventilator, storm, F. Straub 405,189
Saw guide, A. Goulding 405,210
Saw guide, band, R. McChesney 405,110
Saw sharpening and gumming machine, J. F. Quinn 405,178
Scaffold, H. Ayres 405,195
Screens, means for cleaning shaking, H. Seck 405,125
Seat. See Vehicle seat.
Secondary battery, T. H. Hicks 405,213
Separator. See Fluid separator.
Settee ironing board, and clothes rack, combined, W. Norriss 404,978
Sewing machine, W. F. Dial *et al* 405,205
Sewing machine, A. Faulkner 404,965, 404,966
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Sprinkler. See Automatic sprinkler.
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Supporter. See Stocking supporter.
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Switch boards, testing apparatus for, W. E. McKivitt 405,221
Syringe, O. Kloppe 405,100
Table. See Ironing table.
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Track laying machine, F. F. Voigt 404,996
Trap. See Animal trap. Steam trap.
Tub. See Wash tub.
Tube. See Boiler tube. Lamp wick tube. Speaking tube.
Tubes, apparatus for making seamless, I. G. Platt 405,115
Tug holder for vehicles, A. B. Webster 405,136
Typewriting machine, A. Grundy 404,833
Typewriting machine, J. G. Parkinson 405,222
Valve, W. A. Babcock 404,885
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Wheel, G. W. Howell 405,093
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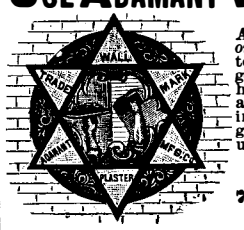

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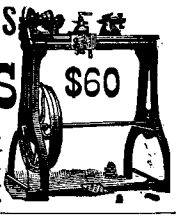

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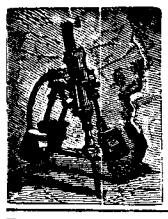

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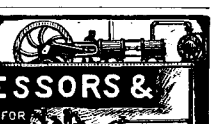

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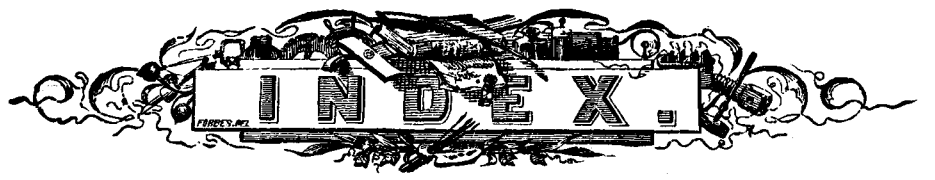

ILLUSTRATIONS.

A

Air batb, simple ... 345
Air brake hose ... 325
Air ship, improved ... 152
Air ship, new ... 358
Alaska and its resources ... 335
Alaska, views in ... 229
Alligators, Chinese ... 278
Amiral Baudin, ship ... 326
Animals, device for catching, Wickham's ... 403
Arches, masonry ... 134
Aspirators, laboratory ... 387
Australia, war ship ... 19
Axle bearing, Strauss' ... 227
Axle, Wilson's ... 115

B

Back, spring, James' ... 403
Balls, collision ... 121
Band saws, guide for ... 354
Barbed wire patent ... 21
Barge, weaving and brush ... 399
Barnard, F. A. P ... 327
Barometer, iod. of mercury ... 135
Barrel, Adams' ... 162
Barrel cover, Lindsay's ... 323
Basket, Adams' ... 226
Bath, air, simple ... 345
Bath tub, Sabin's ... 227
Bell, signal, Olsen's ... 131
Bellows and blow pipe ... 279
Bicycle, Spencer's ... 89
Binder, Wansleben's ... 243
Blow pipe, electric ... 68
Boat, canal, propulsion ... 167
Boats, torpedo ... 402
Boiler, corrugated ... 15
Boiler, locomotive ... 98
Boiler, radial tube ... 306
Boiler, tool for ... 322
Bolster, pillow, Doremus' ... 66
Book case, folding ... 307
Book holder, Brown's ... 162
Book support ... 243
Borax, grinding ... 279
Boring machine, new ... 178
Box, ice cream ... 99
Brake block, Lanyon's ... 194
Brake, car, Kane's ... 99
Brake, car, Mutton's ... 4
Brake shoe, Diedel's ... 114
Brake, vehicle ... 210
Brazing ... 279
Bridge, Firth of Forth ... 38
Bridge, railroad, London ... 351
Bridge, test of, by elephants ... 31
Bridge, Washington, N. Y. City ... 303
Bridge, three-span ... 134
Brush and sponge holder ... 291
Buckboard, Lawrence's ... 194
Buckle, Cole's ... 162
Building blocks, frame ... 259
Bundle carrier, new ... 323
Burglar guard, window ... 83
Burner, hydrocarbon ... 260
Burner, lamp, Ellis' ... 162
Butter worker, Grave's ... 20

C

Cable car transfer ... 371
Cable, ocean, fault in ... 337
Cable propeller ... 370
Cables, subway, forms of ... 246
Cage, lifting, for mines ... 34
Calipers, Green's ... 198
Can opener, King's ... 36
Can spout, Vacher's ... 226
Canal boat propulsion ... 167
Canal, Nicaragua ... 95
Canal, ship, Manchester ... 164
Cane mill, Hughes' ... 83
Capillary force experiments ... 39
Car brake and coupler ... 4
Car brake, Kane's ... 99
Car, cable, transfer ... 371
Car coupling, Byrne's ... 185
Car coupling, Carmona's ... 274
Car coupling, Clarridge's ... 99, 226
Car heater, Sartell ... 146
Cart, road, Lyman's ... 165
Car seat, new ... 371
Car starter, improved ... 131
Car step ... 371
Car step, folding ... 66
Car wheel and bearing ... 148
Cars, heating apparatus ... 136
Carbon rods ... 307
Carriage, a gas propelled ... 9
Cask, shipping ... 339
Caster, safety ... 51
Caudal appendage in man ... 296
Cavern, Jewell ... 339
Chain porter, Pitt's ... 50
Chair, rocking, Gunn's ... 243
Charity institutions, Paris ... 166
Chest, bolting ... 386
Chevreul, Michael E ... 247
Chisel, carpenters', Palmer's ... 404
Church, Greek, at Sitka ... 335
Chuck, lathe ... 338
Clamp, rope ... 243
Cleaner, flue, Oldfield's ... 403
Clevis for plow, Coles ... 115
Clock, electric ... 323
Club exercising ... 228
Clutch, automatic ... 231
Coin package, Castner's ... 227
Connecticut, steamer, engines ... 47
Coupler, car, Mutton's ... 4
Coupling, car, Byrne's ... 185
Coupling, car, Carmona's ... 274
Coupling, car, Clarridge's ... 99, 226
Coupling, car, Nusley's ... 404
Coupling, Swenson's ... 403
Coupling, hose ... 99, 324
Coupling, thill ... 306
Coupling, thill, Loehr's ... 4
Cotton seed cleaner ... 230
Crane, Hercules ... 50
Crane, ten ton ... 136
Crank shaft tester ... 130
Cruiser Vesuvius, trial of ... 56
Crutch attachment ... 4
Cultivator, Landis ... 83
Cultivator, Stagg's ... 291
Current regulator ... 370
Curtain for buggies ... 324

D

Dakota, artesian wells ... 207
Dam, collapse of a ... 369
Dam of Vyrnwy Lake ... 275
Dam, South Fork, collapse ... 323
Delaware, obstructions in the ... 159
Desk and seat, school ... 227
Destroyer, torpedo boat ... 183
Detaching device, animal ... 195
Diaphragms, vibrations of ... 167
Die, screw cutting ... 35
Digger, steam, German ... 163
Dike protector ... 243
Dikes, Weeke's system ... 98
Disaster, appalling ... 369
Disaster, Johnstown ... 406, 407
Ditcher, Perry's ... 35
Ditching machine, Edwards' ... 18
Door hanger, Smith's ... 339
Drainage trap, Shaw's ... 215
Draught equalizer ... 210, 370
Dredging in California ... 319
Drift, sinking ... 399
Drying attach. for kilns ... 323
Dyeing machine ... 132
Dynamite cruiser Vesuvius ... 56

E

Ear piercer, Greenough's ... 114
Eclipse of sun ... 308
Egg poacher ... 211
Eiffel tower ... 375
Electric blow pipe ... 68
Electric clock ... 322
Electric light hanger ... 386
Electric light system, Ball ... 85
Electric subways, New York ... 239
Elevators at Paris Expos ... 310
Elevators, indicator for ... 86
Engine, fire, Ericsson ... 182
Engine, fire, hand cart ... 22
Engine foundations ... 98
Engine, gas, twin ... 230
Engine, locomotive, Strong ... 15
Engine, steam, Beare's ... 148
Engine, steam, Dake's ... 34
Engine, triple expansion ... 294
Engines of str. Connecticut ... 47
Envelope addresser ... 275
Envelope cutter ... 196
Ericsson and his work ... 175
Ericsson, John ... 162
Exhibition, Paris ... 68, 82, 147, 231
Exhibitor for shades ... 99

F

Fan, Syracuse ... 338
Feed bag for horses ... 274
Fertilizer distributer ... 210
Fire engine, Ericsson ... 182
Fire engine, hand cart ... 22
Fire extinguisher ... 370
Fire escape, Abbott's ... 100
Fire escape, improved ... 115
Firth of Forth bridge ... 38
Fish trap ... 308
Foot board for wood choppers ... 210
Foot-shield, piano ... 34
Force, capillary, experiments ... 39
Foundations, engine ... 98
Flames, sensitive ... 179
Frame, crystallizing, Beller's ... 403
Freight yard, New Rochelle ... 127
Furnace, blow pipe ... 279
Furnace for metal ... 150
Furnace for refuse ... 66

G

Gas apparatus, McCullum's ... 51
Gas burner for heating ... 275
Gas engine, twin ... 230
Gas pressure apparatus ... 179
Gate, end, vehicle ... 386
Gate fastening, Coffey's ... 259
Gauge, micro-surface ... 393
Glaciers of Alaska ... 223
Governor, centrifugal ... 230
Grading, hydraulic ... 399
Grate bar, Miller ... 146
Gravel screen ... 324
Greytown ... 95
Grip for cables ... 338
Guard for step ladders ... 115
Guide for band saws ... 354
Gun cotton, manufacture ... 116
Gun, Mannlicher ... 5
Gun, Maxim ... 102
Gunboat, Yorktown ... 69
Guns, indicator for ... 151

H

Halls, Dieulafoy ... 23
Hammock support, Collin's ... 323
Hammock suspension ... 228
Handle for doors ... 194
Harrow, Madson's ... 100
Harrow, rotary ... 195
Hatchway device ... 322
Head rest for car seats ... 4
Heal, Chesley, centenarian ... 89
Heater, car ... 146
Heater, lamp ... 274
Heater, steam, Sperl's ... 114
Hinge, Larimer's ... 274
Hoisting machine ... 146
Hood for stoves ... 195
Hose, air brake ... 325
Hose coupling ... 99, 324
House for switch stands, McCarthy's ... 402
House, summer, cheap ... 179
Hydraulic press, simple ... 71

I

Ice cream box ... 99
Improvements on Mississippi River ... 399
Indicator for elevators ... 86
Indicator for guns ... 151
Injector, Desmond's ... 308
Inking ribbon ... 290
Inkstand, Davis' ... 215
Insulator, Brown's ... 195
Invention, a boy's ... 37
Inventors take courage ... 226

J

Jack, flooring, Townsend & Winslow's ... 402
Jerboa ... 119
Jerboas ... 355
Jewell Cavern ... 339
Johnstown, destruction of ... 383
Jupiter, observations of ... 17

K

Knife cleaner, Jamieson's ... 194
Knife, pocket ... 243
Knife, printer's ... 306
Knife, vegetable, Foote's ... 7

L

Ladder, step, Neill's ... 357
Laff, mud ... 227
Lamp attachment ... 274
Lamp burner, Ellis' ... 162
Lamp, electric, hanger ... 386
Lantern pantographs ... 152
Latch and lock, Kendall's ... 20
Lathe, hand, universal ... 393
Latrobe, John H. B ... 214
Law, Pascal's demonstration ... 71
Leak detector for pipes ... 322
Leg for chairs ... 227
Lemmings ... 355
Lens, sound ... 217
Levee protector ... 243
Life-saving net ... 83
Lightning conductors ... 259
Limbs, artificial ... 377
Loadstone, magnetization by ... 8
Lock for cars ... 386
Lock, nut, novel ... 195
Locomotive boiler ... 98
Locomotive, explosion of ... 70, 262
Locomotive of 1829 ... 182
Locomotive, the Strong ... 15
London, railroad bridge ... 351
Los Angeles, twin palms ... 263
Luggage carrier, bicycle ... 131
Lynx ... 375

M

Machine gallery, Paris Exp ... 82
Magnet for experiment ... 291
Magnetic field ... 8, 121
Magnetism, experiments in ... 242, 262
Map of Nicaragua ... 95
Marmots ... 355
Mat, sub-aqueous, ballasting ... 399
Mat, sub-aqueous, sinking ... 399
Maxim gun ... 102
McCormick Observatory ... 55
Melde's experiment ... 135
Melrose ... 127
Melting apparatus ... 279
Mercury troughs ... 39
Mersey estuary works ... 163
Mill, cane, Hughes' ... 83
Mill, roller, French ... 87
Mill, sugar cane ... 83
Milling machine, universal ... 130
Mine, Tilly Foster ... 367
Mirror for opera glasses ... 291
Mirror, rotating ... 217
Mitrailleuse, Maxim ... 102
Moi boy with tail ... 296
Monitor and Merrimac ... 175
Monitor, turret, inventor ... 245
Motion, vortex ... 329
Motor for light work ... 338
Mud laff ... 227
Museum, Dieulafoy ... 23
Music holder, Brown's ... 162

N

Nest, plant ... 195
Net, life-saving, Hunter's ... 83
New York river front ... 261
New York water supply ... 36
Newton's disks ... 8
Nicaragua canal ... 95
Norway, locomotive explosion ... 262
Nose bag for horses ... 274
Nut lock, novel ... 195

O

Observatory, McCormick ... 55
Oil can, new ... 274
Oil can nozzle ... 146
Opera glasses, mirror for ... 291
Oregon, scenery of ... 287
Ostrich farming ... 211
Oven thermometer ... 259

P

Padlock, Brambel's ... 294
Pail, dinner ... 339
Palms, twin, Los Angeles ... 263
Pan, bake, new ... 259
Pantographs, lantern ... 152
Paris, charity institutions ... 166
Paris Exhibition ... 68, 82, 147, 231
Pascal's law, demonstration ... 71
Patent, barbed wire ... 21
Pavement, Knoche's ... 165
Paving block, Berrie ... 258
Pay device, Bundy's ... 66
Pelayo, war ship ... 198
Pencil sharpener ... 290
Penholder, Poupart's ... 20
Petroleum in manufacturing ... 297
Phonograph recorder ... 167
Physics, experiments in ... 8, 23, 54, 71, 121, 137
Piano foot shield ... 34
Pillow bolster, Doremus' ... 66
Pinch bar ... 354
Pipe coupling, Darrow's ... 162
Pipe, tobacco ... 84
Plant life, curiosity in ... 329
Plant nest ... 195
Platform for thrashing mach ... 307
Plow clevis, Cole's ... 115
Plow, snow, railway ... 258
Plow, snow, Williams' ... 226
Plunger rod for pumps ... 148
Pocket for pencils ... 7
Poison distrib. machine ... 147
Portchester ... 127
Pot, transplanting ... 323
Potato digger, Shaw's ... 228
Potato planter ... 162
Press, hydraulic principle ... 71
Printing frame, photo ... 196
Propeller, cable ... 370
Pump, filter ... 387

R

Rail, compound ... 371
Railroad approaches, New York ... 127
Railroad bridge, London ... 351
Railroad, Rocky Mountain ... 7
Railroad tie, Maloney's ... 82
Railway, Faddis' ... 115
Ram, hydraulic ... 137
Reactionary apparatus ... 137
Rein holder, Adams' ... 323
Revetment, bank ... 399
Rheostat, Crouch's ... 370
Rifle, breechloading ... 118
Rifles, indicator for ... 151
River front, New York ... 261
Rivet holding device ... 322
Road grader, Perry's ... 35
Rope clamp ... 243
Routing machine, new ... 178

S

Sash fastener ... 354
Saw mill dog ... 148
Sawing machine ... 148
Schultze, Mlle., M.D ... 54
Screen, gravel ... 324
Screw cutting die ... 35
Screw driver, Morgan's ... 35
Seal press, Strodtmann's ... 215
Seat, car, new ... 371
Seed cotton cleaner ... 274
Serpents, venemous, U. S ... 295
Seven, sacredness of ... 84
Sewer ventilator ... 86
Sewage disposal ... 119
Shaft support, vehicle ... 165
Ship, air, improved ... 152
Ship, air, new ... 358
Ship canal, Manchester ... 164
Ship canal, Nicaragua ... 95
Ship of war Australia ... 19
Ship of war Pelayo ... 198
Shovel and scraper, snow ... 210
Sieve, pouring water into ... 39
Signal, drawbridge, Long's ... 402
Silo, structure for ... 242
Siphon, mercurial jet ... 264
Siren for velocities ... 359
Sled, steam, Conniff's ... 292
Snakes, venomous, of U. S ... 295
Snow plow, railway ... 258
Snow plow, Williams' ... 226
Snow shovel, new ... 210
Sod cutter, Madson's ... 100
Soldering apparatus ... 279
Sole protector, Lang's ... 386
Sound, experiments in ... 217
Spectrum apparatus ... 54
Spindles, support for, Duffy's ... 404
Sponge holder and brush ... 291
Spring, vehicle, Thomas' ... 51
Square, try and center ... 211
St. Louis to be a seaport ... 39
Stamp and punch, ticket ... 290
Steam boiler, radial tube ... 306
Steam engine, Beare's ... 148
Steam heater, Sperl's ... 114
Steamships, drop-keeled ... 39
Step, car ... 371
Step, car, folding ... 66
Step for vehicles ... 290
Stiletto, torpedo boat ... 276
Stove foot, Fowler's ... 259
Stove hood, Neef's ... 195
Stove pipe support ... 99
Stretcher, wire ... 242
Subways, electric, New York ... 239
Sugar cane mill ... 83
Sun, eclipse of ... 308
Sunshade for vehicles ... 403
Suspender end ... 7
Switchboard, large ... 191

T

Table, kitchen, Brack's ... 18
Telephone Co., Metropolitan ... 191
Telephone, Lowth ... 8
Tenons, turning ... 370
Tension machine ... 281
Tent closing device ... 147
Tent, Gentzen's ... 4
Tent support ... 99
Tester, crank shaft ... 130
Thermometer, oven ... 259
Thill coupling ... 306
Thill coupling, Loche's ... 4
Ticket stamp and punch ... 290
Tie, railroad, metallic ... 82
Tongs, crucible ... 279
Tongs, lamp chimney ... 226
Tool sharpener, England's ... 114
Tornado, recent, in New York ... 49
Torpedo boat ... 324
Torpedo boat Destroyer ... 183
Torpedo boat Stiletto ... 276
Totems ... 343
Tower, Eiffel ... 311, 375
Tower, Eiffel, top of ... 152
Track laying apparatus ... 82
Trap for fish ... 308
Trevelyan rocker ... 135
Tricycle, ocean ... 278
Trough, watering ... 198
Trousers strap ... 290
Truss, Dallas' ... 324
Truss for buildings ... 306
Tunnel, sub river ... 258
Turret, monitor, inventor ... 245
Typesetting machine ... 143
Typewriter, inker for ... 290

V

Valve gear, Harrison's ... 306
Valve, Mason ... 146
Valve, safety, American ... 86
Valve, steam ... 354
Vegetable cutter ... 354
Velocipede, Bowen's ... 131
Vehicle, Lyman's ... 165
Ventilator, sewer ... 86
Vesuvius, cruiser, trial of ... 56
Vibrations, compounding ... 41
Vibration, harmonic ... 23
Vortex rings ... 329
Vyrnwy Lake ... 275

W

War ship Amiral Baudin ... 326
War ship Australia ... 19
War ship Pelayo ... 198
Warrington docks ... 163
Washington bridge, N. Y. City ... 303
Water pipes, frozen ... 7
Water power device ... 83
Water supply, New York ... 36
Waterfalls of Alaska ... 223
Wear iron, Gedney's ... 51
Wells, artesian, Dakota ... 207
Wheel, car, Williams' ... 148
Will-o'-the-wisp ... 361
Window burglar guard ... 83
Wire cloth, designs on ... 84
Wire stretcher ... 242
Wire tightener ... 114
Wood, Rev. J. G ... 248
Wood sawing machine ... 148
Wool washing machine ... 35
Wrench, monkey, French ... 231

Y

Yorktown, gunboat ... 69

MISCELLANY.

Figures preceded by a *star* (*) refer to illustrated articles.

A

Ability, standard of ... 324
Academy of Sciences, National ... 264
Ache in the back ... 117
Acid, handling of ... 20
Acid, oxalomolybdic ... 404
Acid, sulphuric, carriage ... 386
Adhesives for mounting ... 245
Advertising, ingenious ... 277
Advice, not bad ... 387
Advice, Rufus Cook's ... 86
Acrophobia ... 181, 296
Air, admission to rooms ... 68
Air, bad ... 168
Air bath, simple ... *345
Air brake hose ... *325
Air propellers ... 81
Air, respired, poisonous ... 325
Air ship, improved ... *152
Air ship, new ... *358
Air, wet and dry ... 21
Alaska and its resources ... *335
Alaska, views in ... 229
Alcohol ... 185
Algæ, parasitic ... 104
Aliment, new, from wheat ... 273
Alligator, nest of ... 104
Alligators, Chinese ... *278
Allis, E. P ... 248
Alloy, copper steel ... 371
Alloy, new ... 228
Aluminum, alloying with ... 321
Amber fishers of the Baltic ... 52
Am. Ass. for Ad. of Sci ... 404
Amiral Baudin, ship ... *326
Animals, age of ... 184
Animals, device for catching ... *403
Anthony, Edward ... 49
Ants and plant seeds ... 293
Ants, habits of ... 312
Aphasia ... 337
Apia, fuel at ... 261
Apraxia ... 337
Appliances, railway ... 409
Appointments, be prompt in ... 214
Apprentices ... 321
Aquarium cement ... 280
Arbor day ... 224
Arches, masonry ... *134
Architect, trials of a ... 40
Argentine Republic, coal ... 136
Armaments, new ... 96
Arms, small caliber ... 3
Arrow poison ... 306
Arsenic in bone meal ... 305
Arts, lost ... 342
Aspirators, laboratory ... *387
Astrology and railways in China ... 146
Astronomical notes ... 81
Athletes and athletics ... 370
Atrato, steamer ... 81
August a Victoria, steamer ... 396
Australia, war ship ... *19
Axle bearing, Strauss' ... *227
Axle, Wilson's ... *115

B

Back, spring, James' ... *403
Bags, paper, waxed ... 97
Bakers, look out ... 274
Balls, collision ... *121
Balls, small bore ... 7
Bank safes, burglarizing ... 145
Barbed wire patent ... *21
Barnacles, clear off the ... 196
Barnard, F. A. P ... *327
Barnard, President ... 289
Barometer, iodide of mercury ... *135
Barometer scale, new ... 244
Barrel, Adams' ... *162
Barrel cover, Lindsey's ... *323
Basket, Adams' ... *226
Bath, air, simple ... *345
Bath tub, Sabin's ... *227
Battery, plunge, capacity ... 37
Battery, storage, patents ... 214
Batteries, quick firing ... 272
Beetle, elm ... 154
Bell, signal, Olsen's ... *131
Bellows, blow pipe ... *279
Belts, cement for ... 85
Benner's prophecies ... 180
Bergen ferry boat ... 240
Berlin, a model city ... 184
Bicycle, Spencer's ... *89
Bicycles ... 402
Binder, Wansleben's ... *243
Bird's nest, partnership in ... 308
Birmingham Exhibition ... 245
Bishop, W. Irving ... 320
Bleaching blue prints ... 72
Blinds and doors, hanging ... 248
Blood, carbonic oxide vs ... 373
Blow pipe, electric ... *68, 369
Blue, ancient, rediscovered ... 196
Blue, Prussian, solvents ... 213
Boars, wild ... *356
Boat, canal propulsion ... *167
Boats driven by water jets ... 81
Boats, torpedo ... *402
Boiler, corrugated ... *15
Boiler, locomotive ... *98
Boiler, radial tube ... *306
Boilers, tool for ... *322
Bolster, pillow, Doremus' ... *66
Bone meal, arsenic in ... 305
Book camera ... 69
Book carriage, Leith's ... *211
Book case, folding ... *307
Book holder, Brown's ... *162
Book support, Coultas' ... *243
Borax, grinding ... *279
Bore hole, power through ... 305
Boring machine, new ... *178
Box, ice cream ... *99
Brain workers ... 376
Brains in business ... 309
Brake block, Lanyon's ... *194
Brake, car, electric ... 33
Brake, car, Kane's ... *99
Brake, car, Mutton's ... *4
Brake shoe, Diedel's ... *114
Brake, vehicle ... *210
Brazing ... *279
Breech loaders ... 3
Bridge, Firth of Forth ... *38
Bridge, Poughkeepsie ... 16
Bridge, railroad, London ... *351
Bridge, St. Louis ... 136
Bridge, test of by elephants ... *31
Bridge, Washington, New York City ... *303
Bridge, three span ... *134
Bridges and wind pressure ... 243
Bright, John ... 208
Bromide prints ... 3
Bronze, antiquity of ... 393
Bronze, deoxidized ... 213
Bronze, Tobin ... 248
Brush and sponge holder ... *291
Buckboard, Lawrence's ... *194
Buckle, Cole's ... *162
Building blocks, frame ... *259
Building, rapid ... 148
Bulb culture ... 392
Bundle carrier, new ... *323
Burglar guard, window ... *83
Burls ... 319
Burner, hydrocarbon ... *260
Burner, lamp, Ellis' ... *162
Butter maker, Graves' ... *20
Butterflies, 100,000 ... 22

C

Cable car transfer ... *371
Cable, ocean, fault in ... *337
Cable propeller ... *370
Cables, ocean, hemp vs. iron in ... 80
Cables, subway, forms of ... *246
Cage, lifting, for mines ... *34
Cake, electric light ... 198
Calipers, Green's ... *198
Camera, book ... 69
Can opener, King's ... *36
Can spout, Vacher's ... *226
Canal boat propulsion ... *167
Canal, ship, Manchester ... *164
Canal, Nicaragua ... *95
Canal, Nicaragua, cuttings ... 292
Canal, ship, proposed ... 120
Cancer, oyster shells for ... 281
Cane mill, Hughes' ... *83
Cautery, gas as a ... 306
Capillary force, experiments ... *39
Car brake and coupler ... *4
Car brake, electric, trial ... 33
Car brake, Kane's ... *99
Car, cable, transfer ... *371
Car coupiers, self-acting ... 165
Car coupling, Byrne's ... *185
Car coupling, Carmona's ... *274
Car coupling, Clarridge's ... *99, *226
Car heater, Sartell ... *146
Car seat, new ... *371
Car starter, improved ... *131
Car step, folding ... *66
Car step, Wood's ... *371
Car wheel and bearing ... *148
Cars, funeral ... *214
Cars, heating apparatus ... *136
Cars, refrigerator ... 115
Cars, street, postal ... 32
Carbon rods ... *307
Cave, Wyandot ... 149
Carriage, a gas propelled ... *9
Cart, road, Lyman's ... *165
Cat-astrophe, recent ... 292
Caterpillars occupy a railway ... 337
Cattle branding ... 376
Cascade, luminous ... 262
Cask, shipping ... *339
Castor oil ... 341
Castor, safety ... *51
Caudal appendage in man ... *296
Cavalry riding drill ... 345
Cave dwellers in Mexico ... 384
Cavern, Jewell ... *339
Cedrus deodora ... 210
Ceilings, cracked, to save ... 133
Cement for aquariums ... 280
Cement for belts ... 85
Cement, permeability of ... 240
Census machine ... 357
Centennial, Washington ... 288
Chain porter, Pitt's ... *50
Chair, rocking, Gunn's ... *243
Charity institutions, Paris ... *166
Chemistry, experiment in ... 84
Chemistry, teaching ... 178
Chest, bolting ... *386
Chevreul, funeral of ... 361
Chevreul, Michel E ... *247
Chignecto marine railway ... 240
Chill, railways in ... 86
Chimney ventilation for sewage ... 149
China, schools in ... 392
Chisel, carpenters', Palmer's ... *404
Cholera, preventive of ... 3
Chuck, lathe ... *338
Cigar makers, New York ... 113
Cisterns, calculating capacity ... 21
City of Paris, ship ... 245
Clamp, rope ... *243
Clark University ... 389
Clay, purification of ... 70
Cleaner, flue, Oldfield's ... *403
Clevis for plows, Cole's ... *115
Clock, electric ... *322
Cloth of corn husks ... 100
Cloth, wood ... 104
Cloud, smoke, London ... 165
Clouds, a drop from ... 231
Club, exercising ... *228
Clutch, automatic ... *231
Coal ... 21
Coal, gases occluded in ... 89
Coal in Argentine Republic ... 136
Coal mines, old, refilling ... 201
Coasting without snow ... 121
Cocaine, artificial ... *226
Cocoanut crab ... 226
Cocoanut meat ... 129
Cocoanut palm ... 104
Coffee artificial ... 229
Coffee deceptions ... 34
Coin package, Castner's ... *227
Colored surfaces, luminosity ... 37
Coloring matters, new ... 258
Colors, animal, preservation ... 283
Colors, beautiful, sources ... 404
Colors, complementary ... 408
Colors, contrast of in nature ... 51
Colors of flowers, preservation ... 283
Columns, short, weakness ... 130
Combustion, spontaneous ... 307
Comet, Brooks No. 1 ... 53
Compass, rumor about ... 30
Congo, progress on ... 132
Connecticut, steamer, engines ... *47
Constipation, remedy for ... 72
Copra ... 129
Copyright in judicial opinions ... 41
Corn husks, cloth and paper of ... 100
Corn, sweet, origin of ... 104, 149
Corona, whence the ? ... 69
Cotton and wool ... 214
Cotton seed cleaner, new ... *230
Cotton seed, uses of ... 40
Counsel, good ... 117
Country of small things ... 178
Coupler, car, Mutton's ... *4
Couplers, car, self-acting ... 165
Coupling, car, Byrne's ... *185
Coupling, car, Carmona's ... *274
Coupling, car, Clarridge's ... *99, *226
Coupling, car, Nusly's ... *404
Coupling, car, Swenson's ... *403
Coupling, hose ... *324
Coupling, hose, Sloan's ... *99
Coupling, thill ... *306
Coupling, thill, Loehr's ... *4
Crab, cocoanut ... 226
Crane, Hercules ... *50
Crane, locomotive, 10 ton ... *136
Crank shaft tester ... *130
Creditors, preferred ... 278
Creolin in throat disease ... 117
Criminals, experiment with ... 48
Crowley's brains ... 39
Cruiser Piemonte ... 341, 388
Cruiser Vesuvius, trial of ... *56
Crutch attachment ... *4
Cultivator, Landes' ... *83
Cultivator, Stagg's ... *291
Current regulator ... *370
Current to kill an elephant ... 18
Currents, ocean ... 391
Curtain for buggies ... *324
Curves, testing by photography ... 66

D

Daft motor ... 128
Dakota, artesian wells ... *207
Dam, collapse of ... *369
Dam of Vyrnwy Lake ... *275
Dam, South Fork, collapse ... *383
Damascus, tramways in ... 101
De la Rue, Warren ... 328
Death by electricity ... 2
Death, dread of ... 49
Decimal system ... 193
Decisions, Supreme Court ... 64
Delamater, C. H ... 97
Delaware, obstructions in the ... *159
Deodorant, new ... 185
Desk and seat, school ... *227
Destroyer, torpedo boat ... *183
Detaching device, animal ... *195
Developer, hydroquinone ... 212
Developer, new ... 313
Developers, hydroquinone ... 201
Development with water ... 201
Diamond, Julius Pam ... 232
Diaphragms, vibrations of ... *167
Die, screw cutting ... *35
Dike protector ... *243
Dikes, Weeke's system ... *98
Diphtheria, germ of ... 128
Disaster, appalling ... *369
Disaster, Johnstown ... *406
Ditcher, Perry's ... *35
Ditching machine, Edwards' ... *18
Divining rod, recent trials ... 133
Dock, dry, new, Norfolk ... 272
Dog, ancestors of ... 184
Dog, fur ... 184
Door hanger, Smith's ... *339
Door openers, electric ... 313
Doors and blinds, hanging ... 248
Draughtsman, the ... 52
Drainage trap, Shaw's ... *215
Draught equalizer ... *370
Draught equalizer, McDowell's ... *210
Dredger for sand and silt ... 262
Dredging in California ... *319
Drills, rock ... 337
Drying attachment, kilns ... *323
Dye, new, from seaweed ... 180
Dyeing machine ... *131
Dyeing of garments ... 132
Dying, thoughts of ... 359
Dyestuffs, artificial ... 297
Dynamite cruiser, Vesuvius ... *56
Dynamite gun, trial of ... 97
Dynamite shells ... 280
Dynamo and compass ... 400
Dynamo, coupling to a car axle ... 32
Dynamo patents, suit under ... 256

E

Ear piercer, Greenough's ... *114
Earth, danger from drill ... 344
Earth theories ... 389
Earthquakes, cause of ... 193
Earthquakes, effects on animals ... 184
Eclipse of the moon ... 33
Eclipse of sun ... 16, 65, *308
Edison exhibit, Paris ... 372
Eels, poison of ... 184
Egg, hen's, curious ... 372
Egg poacher, Littleton's ... *211
Eiffel tower ... 229, *311, 375
Eiffel tower, elevator for ... 65
Eiffel tower, experiments ... 352
Eiffel tower, scientific uses of ... 326
Eiffel tower, top of ... *152
Electric age ... 264
Electric blow pipe ... *68, 369
Electric car brake, trial ... 33
Electric census machine ... 357
Electric clock ... *322
Electric consolidations ... 132
Electric course at Columbia ... 48
Electric dangers in New York ... 53
Electric distribution ... 16
Electric door openers ... 313
Electric illumination, progress ... 176
Electric lamp hanger ... *386
Electric light consolidation ... 34
Electric light cake ... 198
Electric light men, meeting of ... 96
Electric light system, Ball ... *85
Electric lights, candle power ... 341
Electric Lighting Assoc ... 144
Electric locomotive, Daft ... 128
Electric omnibus ... 305
Electric prostration ... 22
Electric railways ... 134
Electric railways and motors ... 72
Electric spark, projection ... *121
Electric subway explosions ... 208
Electric subways, New York ... *239
Electric welding ... 215
Electric wire, deadly ... 100
Electric wires in gas mains ... 96
Electric wires, removal ... 256
Electrical engineering ... 209
Electrical execution, first ... 337
Electrical exhibition ... 245
Electrical induction ... 325
Electrical plumber ... 341
Electrical practice, beginning ... 307
Electricity and light ... 253
Electricity, death by ... 2
Electricity, executions by ... 181
Electricity, experiments in ... 389
Electricity, horse killed by ... 86

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Electricity in 1888 ... 88
Electricity, labor saved ... 145
Electricity, progress in London ... 196
Electric ty, school of ... 273
Electricity, tanning by ... 327
Electricity, valve for ... 261
Electro-magnetism, discovery ... 7
Electro-physiology ... 37
Elm beetle ... 154
Elementary substances ... 273
Elephant, current to kill ... 18
Elevator for the Eiffel tower, ... 65
Elevators, indicator for ... *86
Elevator, mammoth ... 184
Elevators, Otis, at Eiffel tower ... 402
Elevators, Otis, at Paris ... *210
Emmensite ... 137
Emperor, Chinese, marriage ... 359
Engine, an old Yankee ... 36
Engine, fire, hand cart ... *22
Engine, foundations, elastic ... 193
Engine, gas, twin ... *230
Engine, locomotive, Strong ... *15
Engine, steam, Beare's ... *148
Engine, steam, Dake's ... *34
Engine, triple expansion ... *294
Engines of str. Connecticut ... *47
Engine, steam, friction of ... 84
Engineers, advice to ... 329
Engineers, Am., European trip ... 404
Engineers, Amer., London ... 384
Engineers, Mechanical, Inst ... 352
Engineers, Society ... 7
Engineering, electric ... 209
Engineering societies, Amer ... 145
Engraving wood, American ... 309
Enlargements, photo ... 232
Envelope addresser ... *275
Envelope cutter, new ... *196
Ergosterine ... 166
Ericsson and his work ... *175
ricsson, John ... *168
Escape, providential ... 69
Evil under the sun ... 344
Exhibition, Paris ... *68, *82, 97, *147, 209, 241, *231, 278, 353, 360, 368, 401
Execution, electrical, first ... 337
Executions by electricity ... 181
Executioner, electrical ... 368
Exhibits, scientific ... 337
Exhibition electrical ... 245
Exhibition, French, exhibitors to ... 66
Exhibition, Paris, of 1889 ... 65
Exhibition, photographic ... 33
Exhibitions, floating ... 290
Exhibitor for shades ... *99
Experiment with criminals ... 48
Explosions, electric subway ... 208
Explosive, new ... 319
Explosives ... 321
Exposition, Paris ... 385
Exposition, Paris, U. States, at ... 149
Exposition of U. S. of Colombia ... 81

F

Fakir, glib-talking ... 340
Falls Niagara, changes ... 216
Fan, Syracuse ... *338
Far sight machine ... 345
Fat of ucuhuba ... 338
Feed bag for horses ... *274
Ferryboat Bergen ... 240
Fertilizer distributer ... *210
Fever, scarlet, poison of ... 115
Fever, typhoid ... 6
Fever, yellow, treatment ... 345
Fire department, New York ... 101
Fire engine, Ericsson ... *182
Fire engine, hand cart ... *22
Fire escape, Abbott's ... *100
Fire escape, improved ... *115
Fire extinguisher ... *370
Fire extinguishing app ... 373
Fires burning brightly in winter ... 137
Firemen, new apparatus for ... 257
Fireworks, photographing ... 33
Firth of Forth bridge ... *38
Fish, flying ... 277
Fish, food, history of ... 342
Fish trap, Jenkins ... *308
Fistula, remarkable ... 343
Floors, painting ... 393
Foliage, planning of ... 120
Footboard for wood choppers ... *210
Foot shield, piano ... *34
Force, capillary, experiments ... *39
Forests, climatic influence ... 263
Fortification, modern ... 101
Forts, dismantling ... 336
Foundations, engine, elastic ... *98
Flames, sensitive ... *179
Flats, residence in, danger ... 132
Floated by dead cattle ... 104
Floriculture ... 328
Flour mills, wind power for ... 168
Flowers altered by mites ... 293
Flowers, color, preservation ... 293
Flowers, to preserve color of ... 184
Flume, San Diego ... 361
Frame, crystallizing, Beller's ... *408
Freezing point, lowering ... 361
Freight yard, New Rochelle ... *127
Friction of steam engines ... 84
Fromentine ... 273
Fruit statistics, California ... 312
Fuel at Apia ... 261
Fuel, peach stone ... 201
Fuel, petroleum ... 168
Fund, Elizabeth Thompson ... 408
Funeral cars ... 214
Funeral ceremonies in Paris ... 84
Furnace blow pipe ... *279
Furnace for metal ... *150
Furnace for refuse ... *66
Furniture, bent wood ... 225

G

Garments, dyeing of ... 132
Gas apparatus, McCollum's ... *51
Gas as a cautery ... 306
Gas burner for heating ... *275
Gas check for ordnance ... 280
Gas cylinder, explosion of ... 292
Gas, danger of ... 137
Gas engine, twin ... *230
Gas engines in lamp posts ... 20
Gas from steam boilers ... 197, 229
Gas in heating pipes ... 229
Gas in water pipes ... 280
Gas jets, propulsion by ... 81
Gas, natural ... 134
Gas, natural, in Indiana ... 133
Gas, natural, in Ky. and Ind ... 292
Gas, nat., in mnf. of steel ... 408
Gas, natural, waste of ... 132
Gas occluded in coal ... 84
Gas pressure apparatus ... *179
Gas, purification of ... 281
Gas meter ... 341
Gas well, remarkable ... 291
Gas well, tidal action ... 131
Gas wells, deep ... 214
Gas wells, salt water in ... 136
Gaskill, Harvey F ... 245
Gate, end, Burr's ... *386
Gate fastening, Coffey's ... *259
Gauge, micro-surface ... *393
Geese, transmission in ... 369
Germany, population of ... 9
Girders, biggest ... 405
Glaciers of Alaska ... *223
Glass, ground, to make ... 338
Glass vessels, testing ... 321
Glucose ... 37
Goats, African ... 51
Gold, quest of ... 372
Gold thread, Japanese ... 359
Gold, to precipitate ... 85
Gout, recipes for making ... 80
Governor, centrifugal ... *230
Grader, road, Perry's ... *35
Granite ... 408
Grate bar, Miller ... *146
Gravel screen ... *324
Gravitation, attraction of ... 354
Gravity at different heights ... 149
Greece, excavations in ... 55
Griggs, Joseph M ... 243
Grip for cables ... *338
Grisoutite ... 319, 393
Guard for step ladders ... *115
Guide for band saws ... *354
Gun cotton, manufacture ... *116
Gun, dynamite, trial of ... 97
Gun, first class wanted ... 197
Gun, French, bursting of ... 33
Gun, Gatling ... 197
Gun, machine, Maxim ... *102
Gun, Mannlicher ... *5
Gun, pneumatic ... 3
Guns, great, cost of ... 132
Guns, indicator for ... *151
Guns, machine, in shore defense ... 80
Guns, modern ... 133
Guns of Vesuvius ... 281
Guns, quick firing ... 277
Guns, 13-mile ... 131
Guns, 9 in., at close range ... 327
Gunboat Yorktown ... *69
Gunboat Yorktown, trial of ... 112
Gunpowder, new ... 230

H

Hair, to make it grow ... 181
Halls, Dieulafoy ... *23
Hammock support, Collins' ... *323
Hammock suspension ... *228
Handle for doors ... *194
Harrow, Madson's ... *100
Harrow, rotary ... *195
Harvard College Observatory ... 41
Hastings telescope ... 240
Hatchway device ... *322
Headache ... 325
Head rest for car seats ... 4
Heal, Chesley centenarian ... *89
Health in city and country ... 32
Health notes ... 168
Health resorts, low level ... 361
Heart diseases ... 135
Hearts, weak ... 360
Heat and light ... 329
Heat, laws of ... 296
Heat, radiated, use of ... 48
Heater, car ... *146
Heater, lamp ... *274
Heater, steam, Sperl's ... *114
Hinge, Larimer's ... *274
Hobbies, utility of ... 359
Hoisting machine ... *146
Holy Land railway ... 373
Homes, country, unsanitary ... 88
Hood for stoves, Neef's ... *195
Horse killed by electricity ... 86
Horse power, 18,000 or 20,000 ... 120
Hose, air brake ... *325
Hose, amount in use in U. S ... 245
Hose coupling ... *324
Hose coupling, Sloan's ... *99
Hotel at Coney Island, removal ... 64
Hotel keeper, scientific ... 296
House for switch stands, McCarthy's ... *402
House, summer, cheap ... *179
Houses, flat, dangerous ... 48
Houses, new built, danger ... 168
Houses, underpinning of ... 84
How true it is ... 22
Hurricane, Samoan ... 260
Hydraulic press, principle of ... *71
Hydrazine hydrate ... 259
Hydrochinon developer ... 3
Hydrogen, preparation ... 180
Hydroquinone developers ... 201, 212

I

Ice boating, fast ... 183
Ice cream box ... *99
Idea, value of ... 337
Illiterates ... 2
Illumination, electric progress ... 176
Improvements, Mississippi River ... *399 405
Incendiarism ... 128
Indicator for elevators ... *86
Indicator for guns ... *151
Indigestion ... 275
Indices, improved ... 356
Induction, electrical ... 325
Industrial growth, century of ... 288
Industry, German ... 217
Industries, the world's ... 200
Inebriates, cure of ... 280
Infection, communication ... 391
Injector, Desmond's ... *308
Ink, India ... 200
Ink stains ... 52
Ink, rubber stamp ... 356
Inking ribbon, Roy's ... *290
Inkstand, Davis' ... *215
Insect pests ... 376
Insulator, Brown's ... *195
Intensifier, oxalate ... 33
Interest problem ... 21
Invention, a boy's ... *37
Invention in milling ... 216
Invention, present aspect ... 177
Inventions give employment ... 215
Inventions, half century of ... 290
Inventions, money in ... 178
Inventions, new, prizes for ... 193
Inventions, recently patented 10, 25, 42, 57, 73, 90, 106, 122, 138, 162, 169, 186, 202, 218, 232, 249, 265, 282, 298, 314, 330, 346, 362, 378, 394, 409
Inventive genius, chance ... 358
Inventors, chance for ... 313
Inventors, disarmament of ... 197
Inventors, take courage ... 226
Iodine compounds, explosive ... 277
Iowa, flowing well in ... 101
Iron and steel, analyzing ... 193
Iron and steel, Robert process ... 164
Iron, cast, drilling ... 376
Iron, future of ... 200
Iron in minerals ... 373
Iron, mountain of ... 117
Iron, sheet, Russian ... 72
Irons, aluminum ... 201
Irrigation works ... 273

J

Jack, flooring, Townsend & Winslow's ... *402
Japan ... 212
Japan, small things in ... 178
Japanese as colporteurs ... 263
Jerboa ... *119
Jerboas ... *355
Jewel mineral exhibit ... 248
Jewell Cavern ... *339
Johnstown, destruction of ... *383
Jupiter, observations of ... *17
Jupiter, oscillation of ... 161, 213
Jurisprudence, medical congress ... 393
Jute, rival for ... 161

K

Keeping at it ... 404
Knife cleaner, Jamieson's ... *194
Knife, pocket ... *243
Knife, printers' ... *306
Knife, vegetable, Foote's ... *7

L

Labor in State prisons ... 136
Ladder, step, Neill's ... *357
Laff, mud ... *227
Lakes, the great ... 117
Lamp, attachment for ... *274
Lamp burner, Ellis' ... *162
Lamp, electric, hanger ... *386
Lamp posts, gas engines in ... 20
Lantern pantographs ... *152
Lark, voice of the ... 184
Latch and lock, Kendall's ... *20
Lathe, hand ... *393
Latrobe, John H. B ... *214
Launches, naphtha, tr als of ... 165
Law, going to ... 129
Law, Pascal's, demonstration ... *71
Law, patent, English, changes in ... 121
Lawyers, ways of ... 54
Lead poisoning ... 389
Leak detector for pipes ... *322
Leaves, forms of ... 408
Leg for chairs ... *227
Leland University ... 352
Lemmings ... *355
Lens, sound ... *217
Levee protector ... *243
Leyden, jar, discharge of ... 212
License, engineer's ... 326
Life in New York ... 5
Life saving net, Hunter's ... *83
Light, actinic, artific ... 313
Light and magnetism ... 389
Light, experiments in ... 389
Light, penetration of water ... 313
Lightning conductor, fence ... *259
Lightning, crew disabled by ... 9
Limbs, artificial ... *377
Lion, operation on ... 179
Lithographic work, photo ... 356
Loadstone, magnetization by ... *8
Lock for freight cars ... *386
Lock, nut, novel ... *195
Locomotive boiler ... *98
Locomotive, electric, Daft ... 128
Locomotive exhibit, French ... 401
Locomotive, explosion ... *70
Locomotive explosion, Norway ... *262
Locomotive of 1829 ... *182
Locomotive, Strong, runs of ... 244
Locomotive, the Strong ... *15
Locomotive works, French ... 257
Logs, scientific ... 96
London railroad bridge ... *351
London subway, new ... 361
Longevity, increasing ... 308
Loom, the ... 217
Los Angeles, twin palms ... *263
Lozenge, a starry ... 96
Lubrication, air compressor ... 309
Lubricants, semi-solid ... 292
Luggage carrier, bicycle ... *131
Lynx, the ... *375

M

Machine, far sight ... 345
Machine gallery Paris Exposition ... *82
Machines, effect on trade ... 244
Machinery, American, abroad ... 373
Magnet for experiment ... *291
Magnetic field ... *8, *121
Magnetism, effect of light on ... 389
Magnetism, experiments in ... *242, *262
Marble, moss ... 167
Marine conference ... 304
Mark, trade, advantages ... 403
Marmots ... *355
Mars, canals of ... 81
Mars, the planet ... 24
Match box, water tight, wanted ... 133
Mausoleum, new ... 384
Maxim machine gun ... *102
Meal, cotton seed ... 40
Melde's experiment ... *135
Melons, concerning ... 392
Melrose ... *127
Melting apparatus ... *279
Men, live ... 17
Meningitis, tubercular ... 358
Mercury troughs ... *39
Metal, liquid, rolling ... 368
Metal, new, in nickel ... 338
Metals, luster of ... 100
Metals, new ... 387
Metallurgic notes ... 201
Meter, a large ... 341, 388
Meteor, remarkable ... 137
Meteorological apparatus ... 24
Meteorites ... 177
Metric system ... 193
Mexico, railways of ... 129
Mexico, ruins in, more ... 81
Microscopy at Brooklyn Institute ... 305
Mile a minute ... 183
Military examinations ... 3
Milk, heating, effect ... 388
Milk, preservation of ... 292
Mill, cane, Hughes' ... *83
Mill, roller, French ... *87
Mill, sugar cane ... *83
Milling machine, universal ... *130
Mind, child's, growth of ... 358
Mine, Tilly Foster ... *367
Minerals, separating ... 360
Minutes since year one ... 161
Mirror for opera glasses ... *291
Mirror, rotating ... *217
Mitraille use, Maxim ... *102
Moi boy with tail ... *296
Money, ninety-three millions ... 129
Money, real value of ... 151
Monitor and Merrimac ... *175
Monitor Puritan ... 341
Monitor turret, inventor ... 216, *245
Moon, eclipse of the ... 33
Morphine, new antidote ... 262
Mortar, thick, in brickwork ... 160
Mosquitoes, to expel ... 385
Mosquitoes, to keep off ... 373
Motion, perpetual ... 160
Motion, vortex ... *329
Motive power, Paris Exposition ... 180
Moths, concerning ... 273
Motors, electric ... 72
Motor for light work ... *338
Mountain of iron ... *117
Mud laff ... *227
Museum, Dieulafoy ... *23
Music a preventive of phthisis ... 4
Music holder, Brown's ... *162
Myrtol ... 196

N

Nail holes, filling for ... 371
Natural history notes ... 104, 184, 293
Naval speed, limit of ... 328
Navigation, steam, revolution in ... 352
Navy, American ... 129
Navy, British, proposed increase ... 161
Navy, new ... 308
Navy, United States ... 185
Negatives, developing ... 392
Neptune, satellite of ... 53
Nest, propagating ... *195
Net, life saving, Hunter's ... *83
Newspaper notes ... 161
New South Wales, salt beds in ... 257
New York fire department ... 101
New York, life in ... 5
New York river front ... *261
New York water supply ... *36
Newton's disks ... *8
Niagara Falls, changes ... 216
Nicaragua canal ... *95
Nicaragua canal, cuttings ... 292
Nitrogen ... 194
Norfolk, dry dock at ... 272
Norway, locomotive explosion ... *262
Nose bag for horses ... *274
Notes, miscellaneous ... 100
Notices, threatening ... 180
Nut lock, novel ... *195
Nutmegs in New Guinea ... 5

O

Oatmeal as a food ... 22
Observatory, Harvard College ... 41
Observatory, McCormick ... *55
Ocean currents ... 391
Ocean record broken ... 337
Ocean voyage, remarkable ... 304
Ohm, George Simon ... 113
Oil can, new ... *274
Oil can nozzle ... *146
Oil, castor ... 341
Oil, cotton seed ... 40
Oil fuel, insurance restrictions ... 85
Oil on the waves ... 51
Oklahoma ... 292
Omnibus, electric ... 305
Ordnance, gas check for ... 280
Ordnance work ... 273
Oregon, scenery of ... *287
Organ, Albert Hall ... 37
Organs, internal, illuminating ... 211
Ostrich farming ... *211
Oven thermometer ... *259
Overcoats ... 113
Oxygen ... 65
Oxygen, none in sun ... 368

P

Padlock, Brambel's ... *291
Pail, dinner ... *339
Paint, anti-fouling ... 371
Paint, roof ... 341
Paint the shingles ... 181
Paints, luminous ... 372
Palm, cocoanut ... 104
Palms, twin, Los Angeles ... *263
Pan, bake, new ... *259
Pantographs, lantern ... *152
Paper bags, waxed ... 97
Paper, chloride, working ... 53
Paper, examination of ... 281
Paper from wood ... 115
Paper of corn husks ... 100
Paper, ready sensitized ... 33
Paper, sensitizing ... 225
Paraldehyde as a hypnotic ... 264
Paraldehyde habit ... 264
Parasites, propagation of ... 179
Parents, age, and vital, child ... 280
Paris, charity institutions ... *166
Paris Exhibition ... 65
*68, *82, 97, *147, 209, *231, 241, 278, 353, 360, 368
Paris Exposition ... 385
Paris Exposition, U. S. at ... 149
Pascal's law, demonstration ... *71
Patent, barbed wire ... *21
Patent law, English, changes in ... 121
Patent office and inventor ... 344
Patent office, complaints against ... 64
Patents, assist. com. of, new ... 224
Patents, commissioner of, new ... 192
Patents, com., report of ... 112
Patents, decisions relating to ... 21, 101, 181, 385
Patents, delay in granting ... 256
Patents, dynamo, suit under ... 256
Patents, foreign, securing ... 321
Patents, good, results of ... 37
Patents, partnership, property ... 281
Patents, storage battery ... 214
Patterns, photographing ... 281
Pavement, Knoche's ... *165
Paving block, Berrie ... *256
Pay device, Bundy's ... *63
Peach stone fuel ... 201
Pearce, Sir William ... 161
Pelayo, war ship ... *198
Pen, ruling, new ... 21
Pencil sharpener ... *290
Penholder, Poupart's ... *20
Perfumes, home made ... 281
Peru, railways in ... 85
Petroleum, a lake of ... 165
Petroleum, dangers of ... 232
Petroleum for fuel ... 168
Petroleum for manuf. purposes ... *237
Petroleum, Russian ... 116
Philippine Islands ... 200
Phonograph, curiosities of ... 23
Phonograph recorder ... *167
Phosphorescent powders ... 372
Photo, lithographic work ... 356
Photo, transparencies ... 17
Photographers, congress of ... 101
Photographic congress ... 3
Photographic notes ... 3, 33, 201, 212, 225, 245, 313, 392
Photographing on wood ... 392
Photography and the weather ... 393
Photography, automatic ... 392
Photography of patterns ... 281
Photography, instantaneous ... 50
Phthisis from house sweepings ... 329
Phthisis, music a preventive ... 4
Phthisis, tannin in ... 280
Physics, experiments in ... *8, *23, *54, *71, *121, *137
Phylloxera in Elba ... 88
Phsiology, electro ... 37
Piano foot shields ... *34
Piemonte, cruiser ... 341, 388
Pillow bolster, Doremus' ... *66
Pinch bar ... *354
Pipe coupling, Darrow's ... *162
Pipe, steel ... 263
Pipe stoppers or plugs ... 133
Pipe, tobacco ... *34
Pipes, wrought iron ... 212
Planets, position of in January ... 2
Planets, position in February ... 49
Planets, position in March ... 145
Planets, position in April ... 192
Planets, position in May ... 256
Planets, position in June ... 336
Planets, position in July ... 401
Plant growth, effect minerals ... 293
Plant, laughing ... 184
Plant life, curiosity in ... *329
Plant nest ... *195
Plant, weather ... 184
Plante, Gaston ... 386
Plants, epiphytic, tropical ... 293
Plants, productive secretions ... 293
Platform for thrashing machine ... *307
Plating with aluminum ... 225
Plater of Paris, hardening ... 181
Plow clevis, Cole's ... *115
Plow, snow, railway ... *258
Plow, snow Williams' ... *226
Plumber, electrical ... 341
Plumber, trick of a ... 132
Plunger rod for pumps ... *148
Pocket for pencils ... *7
Poison distrib. machine ... *147
Polariscope, improved ... 69
Population in cities, growth of ... 197
Population of U. S ... 404
Portchester ... *127
Postal tube, English ... 392
Post office, hard work at ... 113
Posts, wood, in fires, endurance ... 72
Pot, transplanting ... *323
Potato digger, Shaw's ... *228
Potato planter, Ohlson's ... *162
Potomac flats ... 3
Poughkeepsie bridge ... 16
Power, motive, Paris Exposition ... 180
Power, transmission of ... 305
Pratt Institute ... 177
Press, hydraulic, principle ... *71
Printing frame, photo ... *196
Prints, blue, bleaching ... 72
Prints, measly ... 225
Prison labor ... 136
Prison labor contracts ... 41
Proctor, Mrs., pension for ... 208
Proctor, Professor ... 213
Prophecies, Benner's ... 180
Propeller, cable ... *370
Propellers, screw ... 356
Propulsion, new system ... 180
Prospects, naval and maritime ... 160
Pump and condenser ... *232
Pump, filter, Bunsen ... 387
Purdue University ... 392
Puritan, monitor ... 341
Puritan, steamer ... 388

Q

Quartz as an insulator ... 308
Query 22 ... 69

R

Rabbit pest, Australian ... 272
Rabbit skins ... 6
Rail, compound ... *371
Rails, rusting of ... 21
Rails, steel, prospects ... 360
Railroad approaches, New York ... *127
Railroad, Rocky Mountain ... *7
Railroad tie, Maloney's ... *82
Railroading, fast ... 35
Railway, Faddis' ... *115
Railway, Holy Land ... 373
Railway, horse, strikes on ... 104
Railway, marine, Chignecto ... 240
Railway, Northern Pacific ... 193
Railway station, largest ... 18
Railway tunnel, United States and Canada ... 41
Railways, African ... 100
Railways and astrology in China ... 146
Railways, early, sails on ... 376
Railways, electric ... 72, 134
Railways in Chili ... 86
Railways, Mexican ... 129
Railways, Peruvian ... 85
Railways, street, New York ... 114
Railways, telephone on ... 241
Rains, ink ... 52
Ram, hydraulic ... *137
Ramie, cleaning ... 200
Rats ... 49
Rats, bait for ... 304
Rats' tails ... 321
Reactionary apparatus ... *137
Registers, physician's ... 336
Reinholder, Adams' ... *323
Repairing, quick ... 130
Report of sec. of war, items ... 3
Republic, Argentine ... 280
Republics, South American ... 200
Reservoir, ancient ... 232
Rheumatism, turpentine for ... 297
Rheostat, Crouch's ... *370
Rice, Allen Thorndike ... 321
Rifle, automatic ... 117
Rifle barrels, treatment ... 226
Rifle, breech loading, test ... *118
Rifles, indicator for ... *151
Rifles, cast iron ... 3
Risks in city streets ... 313
River front, New York ... *261
Rivet holding device ... *322
Road grader, Perry's ... *35
Roaring, cure for ... 248
Rope clamp ... *243
Routing machine ... *178
Rubber, facts about ... 216
Rubber, to melt ... 7
Rules, some golden ... 5
Ruins, Mexican, more ... 81
Ryland, Mr., tragic fate ... 113

S

Saccharine prohibited in France ... 85
Safes, bank, burglarizing ... 115
Salt beds in New South Wales ... 256
Salt, forty-five foot bed ... 24
Salt, Kansas ... 194
Salt, to prevent packing ... 193
Salt water in gas wells ... 136
Salt water wells ... 231
Samoa, hurricane at ... 260
San Diego flume ... 361
Sand and silt, dredging ... 262
Sands, sifting for valuables ... 4
Sandwich Islands, population ... 168
Sash fastener ... *364
Satellite of Neptune ... 53
Saturn, changes on ... 197
Saturn, outer ring of ... 261
Saw mill dog, Flesher's ... *148
Sawing machine ... *148
Scarlet fever poison ... 115
Schools in China ... 392
Schools, industrial ... 145
Schools, trade ... 100
Schultze, Mlle. M. D ... *54
Science, works on, prizes ... 149
Science, National Acad ... 264
Sciences, paradoxes of ... 217
Screen, panel ... *324
Screw cutting die ... *35
Screw driver, Morgan's ... *35
Sea water, compressibility ... 121
Seal press, Strodtmann's ... *148
Seaweed, dye from ... 130
Seed cotton cleaner ... *274
Serpents, venomous, of U. S ... *295
Seven, sacredness of ... 84
Sewage disposal ... *119
Sewage, ventilation for ... 149
Sewer ventilator ... *86
Shaft support, vehicle ... *165
Shafts, iron ... 373
Shellac varnish ... 146
Shingles, paint the ... 181
Ship, air, improved ... *152
Ship, air, new ... 358
Ship canal, Manchester ... *164
Ship canal, Nicaragua ... *95
Ship canal, proposed ... 120
Ship channel, Quebec ... 168
Ship of war Australia ... *19
Ship of war Pelayo ... *198
Ship, war, largest ... 50
Ships of war, 1888 ... 308
Ships, new, for U. S. Navy ... 17
Ships, steel, corrosion of ... 149
Ships, war, American and Italian ... *384
Ships, war, English ... 213
Ships, war, French ... 353
Shoe, brake ... *114
Shorthand, physiology of ... 197
Shovel, snow, and scraper ... *210
Sieve, pouring water into ... *39
Signal, drawbridge, Long's ... *402
Signals, time, by magnesium ... 385
Silo presses and ensilage ... 405
Silo, structure for ... *242
Silver compounds, explosive ... 277
Sinks, disinfecting ... 85
Siphon, mercurial jet ... *264
Siren for velocities ... *359
Sleep, normal, cause of ... 264
Sled, steam, Conniff's ... *292
Snake, harlequin ... 373
Snakes, venomous, of U. S ... 295
Snow, black, fall of ... 224
Snow plow, railway ... *258
Snow plow, Williams' ... *226
Snow shovel, Fairweather's ... *210
Soapstone and its uses ... 353
Society, Pomological, American ... 225
Sod cutter, Madson's ... *100
Soda fountain ... 344
Soldering apparatus ... *279
Sole protector, Lang's ... *386
Solutions, mounting ... 33
Soot, prevention of ... 5
Sound, experiments in ... *217
Sounds, inaudible, made audible ... 21
Sparrow pest ... 129
Spectrum apparatus ... *54
Speed, naval, limit of ... 328
Sperrylite ... 162
Spindles, support for, Duffy's ... *404
Spontaneous combustion ... 35
Spools, thread ... 34
Spring, vehicle, Thomas' ... *51
Springs, petrifying ... 181
Square, try and center, Chaplin ... *211
Squirrel, industrious ... 217
St. Louis to be a seaport ... *39
Stamp and punch, ticket ... *290
Stanley, explorer ... 224
Star gazers, for ... 65
Stars, shooting, light of ... 217
Steel and iron, analyzing ... 193
Steel and iron, Robert process ... 164
Steel, Henderson ... 121
Steel ships, corrosion of ... 149
Steel, tempered, experiments ... 54
Steel, manganese ... 201
Steam engine, Beare's ... *148
Steam engine, old Yankee ... 36
Steam engines, friction of ... 84
Steam heater Sperl's ... *114
Steam jet, coloring ... 345
Steamer Atrato ... 81
Steamer Augusta Victoria ... 336
Steamer, Channel, new ... 326
Steamer, passenger, fast ... 272
Steamer Puritan ... 388
Steamer raised by dead cattle ... 104
Steamers, British Canadian ... 389
Steamers, ocean, speed of ... 312
Steamship, great, arrival ... 245
Steamships, American ... 166
Steamships, drop-keeled ... *39
Steel process, new ... 389
Step, car, folding ... *66
Step for ve icles ... *290
Step ladder, Neill's ... *357
Stiletto, torpedo boat ... *276
Stomach, foreign bodies in ... 357
Stove hood, Neef's ... *195
Stove foot, Fowler's ... *259
Stove pipe support ... *99
Street cars, postal ... 32
Streets, city, risk in ... 343
Stretcher, wire ... *242
Strikes, horse railway ... 104
Structures, high oscillations ... 209
Subway, new, London ... 361
Subways, electric, New York ... *239
Sucker fish and turtle fishing ... 166
Sugar, artificial ... 229
Sugar cane mill ... *83
Sugar, history of ... 313
Sugar refining deception ... 17
Sulphite in Germany ... 82
Summer resorts, housetop ... 305
Summers, Thomas ... 328
Sun, eclipse of ... 16, 65, *308
Sunshade for vehicles ... *403
Sun spots ... 81
Supply, water, New York ... 400
Surfaces feebly sens. to light ... 40
Suspender end ... *7
Swallow, sleep of a ... 104
Swallows, cunning of ... 184
Sweden, telephones in ... 258
Switchboard, large ... *191

T

Table, kitchen, Brack's ... *18
Tanning by electricity ... 327
Tarantula and its foe ... 9
Tattoo marks ... 359
Teak wood ... 225
Telea polyphemus, notes on ... 405
Telegraph man outwitted ... 354
Telegraph poles, testing ... 88
Telegraph, Western Union ... 242
Telephone, cheap ... 207
Telephone Co., Metropolitan ... 82, *191
Telephone investigation ... 130
Telephone, Lowth ... *8
Telephone vibrations ... 393
Telephone, use on railways ... 241
Telephones in Sweden ... 258
Telephony, long distance ... 226
Telescope, Hastings ... 240
Telescope, Lick ... 401
Telescope, $1,000,000 ... 17
Tenons, turning ... *370
Tension machine ... *281
Tent closing device ... *147
Tent, Gentzen's ... *4
Tent support ... *99
Tester, crank shaft ... *130
Tetanus, treatment of ... 355
Thalessa and tremex, habits ... 339
Thermometer, new ... *259
Thill coupling ... *306
Thill coupling, Loehr's ... *4
Think, learning to ... 322
Thread, spools ... 34
Throat disease, creolin in ... 117
Throat, sore, preventive ... 34
Tidal action in gas well ... 131
Tie, railroad, metallic ... *82
Ties, consumption of ... 355
Tiffany exhibit of minerals ... 248
Tigers, plague of, in Java ... 120
Time servers ... 201, 273
Time, standard ... 100
Times, going with the ... 20
Timber, expansion of ... 241
Timber, small, better than large ... 6
Timber, supply of U. States ... 290
Tobin bronze ... 248
Tongs, crucible ... *279
Tongs, lamp chimney ... *226
Tool sharpener, England's ... *114
Topsail rig ... 325
Tornado, recent, in New York ... *49
Tornado, the ... 32
Torpedo boat ... *324
Torpedo boat, Destroyer ... *183
Torpedo boat, new ... 228
Torpedo boat, Stiletto ... *276
Torpedo boats, Spanish ... 197
Totems ... *343
Tower, Eiffel ... 229, *311, *375
Tower, Eiffel, experiments ... 352
Tower, Eiffel, scientific uses of ... 326
Tower, Eiffel, top of ... *152
Traces, elastic ... 2
Track laying apparatus ... *82
Trade mark ... 224
Trade marks, foreign ... 68
Trade mark, hints on ... 53
Trade mark infringement ... 120
Trade, learn a ... 165
Train, fast ... 240
Tramways in Damascus ... 101
Tramways, street, New York ... 114
Transparencies, photo ... 17
Trap for fish ... *308
Tree sawing, dangers of ... 151
Trees, blasting holes for ... 215
Trees, felling by electricity ... 389
Trees, planting ... 370
Trees, to protect from borers ... 257
Trees with large leaves ... 133
Treveylan rocker, exper ... *135
Tricks, juggler's ... 21
Tricycle, ocean, Lake's ... *278
Trough, watering ... *198
Trousers strap, Carter's ... *290
Truss, Dallas' ... *324
Truss for buildings ... *306
Tunnel between United States and Canada ... 41
Tunnel, sub-river ... *258
Turret, Monitor, inventor ... 216, *245
Typesetting machine ... *143
Typewriter inker ... *290
Typhoid fever ... 6

U

Ucuhuba, fat of ... 338
Underpinning of houses ... 84
University, Clark ... 389
University, Leland ... 352
University, Purdue ... 392

V

Vaccination ... 105
Valkyrie, yacht ... 320
Valve for electricity ... 261
Valve gear, Harrison's ... *306
Valve, Mason ... *146
Valve, safety, American ... *86
Valve, steam, Gheen's ... *354
Vancouver water works ... 81
Vanillin, use of ... 6
Varnish, negative, substitute ... 212
Varnish, shellac ... 146
Vegetable cutter ... *354
Velocipede, Bowen's ... *131
Vehicle, Lyman's ... *165
Ventilation for sewage ... 149
Ventilating our homes ... 85
Ventilator, sewer ... *86
Venus, the evening star ... 113
Vessels, propulsion of ... 180
Vessels, war prospects ... 176
Vesuvius cruiser, trial of ... *56
Vesuvius in eruption ... 376
Vesuvius, performance of ... 31
Vibration, harmonic ... *23
Vibrations, compounding ... *41
Villa, continental ... 70
Viscosity, magnetic ... 232
Vortex rings ... *329
Voyage, ocean, remarkable ... 304
Vyrnwy Lake ... *275

W

Wages, to increase ... 392
Wages, United States ... 368
Walls, party, law as to ... 180
Walls, straightening ... 309
War material of American design ... 192
War, naval, of the future ... 160
War ship Amiral Baudin ... *326
War ship Australia ... *19
War ship, largest ... 50
War ship, Pelayo ... *198
War ship, U. S., new ... 17
War ships, American and Italian ... 384
War ships, English ... 213
War ships of 1888 ... 308
War vessels, French, new ... 353
War vessels, new ... 16
War vessels, prospects of ... 176
Wars, naval, of the future ... 80
Warts, treatment of ... 148
Washington bridge, New York City ... *303
Washington, centennial ... 288
Watch manufacturing ... 329
Water, boiled, for tea ... 339
Water, danger in ... 168
Water, drinking, dangers of ... 149
Waterfalls of Alaska ... *223
Water jets, propulsion by ... 81
Water pipes, frozen ... *7
Water pipes, standard ... 393
Water power device ... *83
Water supply for New York ... *36
Water works, Vancouver ... 81
Waves, oiling the ... 51
Wax, sheet, how to make ... 263
Wear iron, Gedney's ... *51
Weather, northwestern ... 325
Welding, electric ... 215
Well, artesian, a deep ... 149
Well, flowing, in Iowa ... 101
Well, gas, remarkable ... 291
Well, grant in California ... 309
Wells, artesian, Dakota ... *207
Wells, artesian, work of ... 100
Wells, blowing ... 133
Wells, deep, of Reading ... 83
Wells, gas, deep ... 214
Wells, salt hot water ... 231
Wheat, ailment from ... 273
Wheat in geranium stalk ... 117
Wheel, car, Williams' ... *148
Wheels, facts as to ... 248
Will-o'-the-wisp, scientific ... *361
Willmerding, Pa ... 273
Window burglar guard ... *83
Wire clock designs on ... *84
Wire, the deadly ... 100
Wire, phosphor bronze ... 373
Wire stretcher ... *242
Wire tightener ... *114
Wires, electric, in gas mains ... 96
Wires, electric, removal ... 256
Wires in subways ... 292
Woman's place in nature ... 306
Wood clock ... 104
Wood, the fashionable ... 137
Wood paper ... 115
Wood posts in fires, endurance ... 72
Wood pulp mill, large ... 4
Wood, Rev. J. G ... *248
Wood, Rev. J. G. death of ... 198
Wood sawing machine ... *148
Woods, relative hardness ... 49
Wool, Berlin, for sore throat ... 34
Wool and cotton ... 214
Wool washing machine ... *35
World, celestial ... 96, 161
World, New York, reply to ... 112
Work deliberately ... 36
Wrecks, floating ... 289
Wrench, monkey, French ... *231
Wyandot cave ... 149

Y

Yacht Valkyrie ... 320
Yachts, steam, speed trials ... 165
Yorktown, gunboat ... *69
Yorktown, gunboat, trial ... 112
Young, Col. F ... 263

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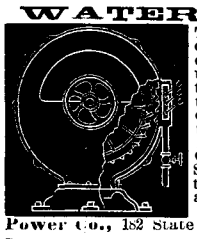

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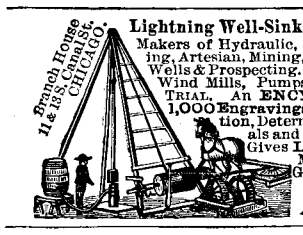

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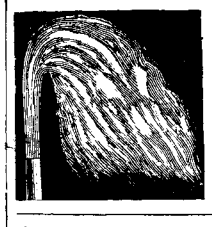

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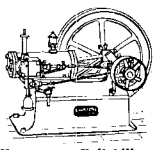

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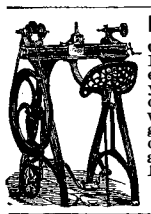

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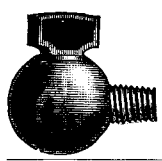

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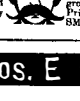

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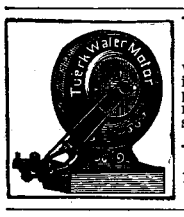

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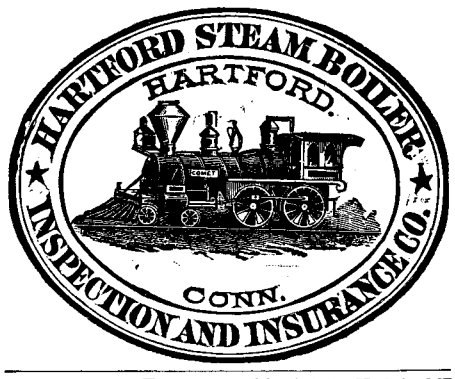

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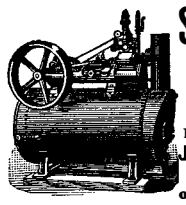

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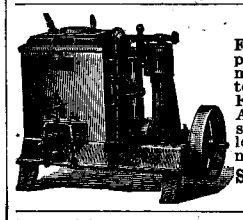

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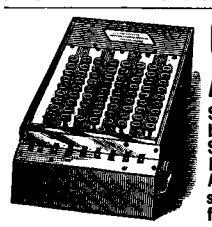

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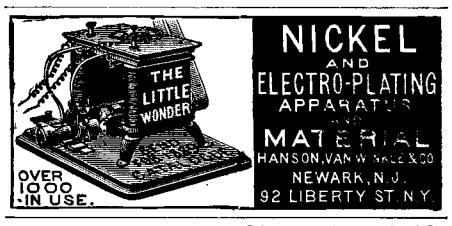
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